

A Report on the Status and Management of Native Prairie  
Areas in National Parks and Monuments in the Midwest Region

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September 30, 1975

## Contents

Introduction

Pipestone National Monument

Herbert Hoover National Historic Site

Effigy Mounds National Monument

Homestead National Monument

Scotts Bluff and Agate Fossil Beds National Monument

Fort Larned National Historic Site

Wilson's Creek National Battlefield

George Washington Carver National Monument

Ozarks National Scenic Riverway

Indiana Dunes National Lakeshore

Annotated Prairie Bibliography

## Introduction

The vast prairie landscape, which once was characteristic of much of the Midwest, particularly West of the Mississippi River, has been transformed in slightly more than a century into one of the world's most productive agricultural regions. The vastness, once unbroken except for occasional trails, villages and patches of trees, is interrupted today in every long distance view by highways, high lines, or high rise apartments, essential features of our civilization. But the prairie species persist, if only a fraction of the original biomass, in enclaves created by variations in the land surface and through deliberate action by humans. This report summarizes observations made during Summer 1975 on some of these enclaves from Indiana to western Nebraska and Minnesota to southern Missouri.

Much has been written about the extent of the original prairie in North America. Occasionally applied to the entire Grassland Formation, the term "Prairie" is more often restricted in use to the eastern half of the grassland where it was first used by French explorers along the Mississippi River. I will use it in the more restricted sense to cover grasslands from Canada to the Gulf of Mexico usually bordering on Deciduous Forest to the east and short grassland to the west, realizing, however, that the boundaries are dynamic. The Prairie Peninsula extends eastward into Indiana, where it ceases to maintain connected units, but extends even further as oak openings into Ohio.

The dominant species of the prairie are primarily tall grasses, several feet to 10 feet tall. Mixed with the grasses are members of two other important families, Legumes and Composites, and few members of many other

families. Although it is the grass family that characterizes the prairie from a traditional point of view, it is the array of colorful flowers blooming from spring to fall which often brings the visitor back again and again to see the flower gardens of the prairie.

Fire is an important environmental force in prairie dynamics. Perhaps underrated in the early years of research on prairie vegetation as an important factor in the control of woody plant invasion, fire may at this time be overrated by a generation of ecologists who have burned prairie under prescribed conditions in almost every region of the Midwest. The response from burning depends on many conditions; however the response from early spring burning is most of the Midwest seems to result in more vigorous prairie species and less vigorous woody plants.

The prairie soils support the heart of North American agriculture. Unlike the forest soils, which are formed with an accumulation of organic matter on top the ground, the prairie soils have organic matter distributed through the soil profile by rapid turnover of fibrous root systems of grasses and abundant nitrogen fixation by the root nodule bacteria of legumes. The prairie soils, more than any other characteristic, led to the downfall of the prairie. Prairie species, adapted to eons of extremes of moisture, temperature, grazing, and fire, were no match for the plow. What could survive the extremes of mid continental climate would not survive the technology of productive agriculture except as small remnants. These are some of the remnants of which I write.

## Pipestone National Monument

### I. Historical Setting

Pipestone National Monument was established by an Act of Congress on August 25, 1937; however, for hundreds of years previously the pipestone or catlinite and quartzite outcrops attracted people to the area. "Traditionally this was a sacred place where all Indians could come and quarry in peace . . ."

(1). Squabbles over access to the area apparently arose among the Indians during the 19th Century and in 1893 the land was taken over by the U.S. Government under the laws of eminent domain to establish a Federal Indian School. There are 283 acres comprising the monument; the 80 acres to the west were added in 1956.

### II. Natural History of Area Related to Prairie

George Catlin, although not the first white person to visit the area, was the first person to describe scenes by writing and painting which can be used today to recreate the original setting. "When he sketched this rock ledge in 1836, there were few trees, nor any on the surrounding plain. Suppression of fire and introduction of plants not native to the region have changed the character of the land greatly, and left it dependent on continued management" (2). There is little doubt that there has been an increase in woody shrubs and trees, especially along the quartzite outcrop, but changes in the herbaceous plants of the prairie may have been relatively slight, except for portions once cultivated. The natural vegetation of Pipestone National Monument is Bluestem Prairie, consisting of dense vegetation of tall grasses and forbs (3). Big bluestem (Andropogon gerardi), Little bluestem (Andropogon scoparius), Switchgrass (Panicum virgatum), and Indian grass (Sorghastrum nutans) are dominants with other components consisting of Leadplant (Amorpha canescens), Pussytoes (Antennaria neglecta), Little white

aster (Aster ericoides), False indigo (Baptisia leucantha and B. leucophaea), Side-oats grama (Bouteloua curtipendula), Daisy fleabane (Erigeron strigosus), Bedstraw (Galium tinctorum), Big tooth sunflower (Helianthus grosseserratus), June grass (Koeleria cristata), Blazing star (Liatris aspera, L. punctata, and L. scarriosa), Scribner's panic grass (Panicum scribnerianum), Prairie phlox (Phlox pilosa), Silverleaf scurfpea (Psoralea argophylla), Long headed coneflower (Ratibida columnifera), Yellow coneflower (Ratibida pinnata), Long headed coneflower (Ratibida columnifera), Yellow coneflower (Ratibida pinnata), Prairie rose (Rosa arkansana), Compass plant (Silphium laciniatum), Goldenrod (Solidago altissima and S. missouriensis), Stiff goldenrod (Solidago rigida), Prairie dropseed (Sporobolus heterolepis), and Porcupine grass (Stipa spartea). Most of the above species were observed in the area. Other prairie species (5) which were observed included Tipsin (Psoralea esculenta), Showy sunflower (Helianthus laetiflorus), Maxmillian sunflower (Helianthus maxmilliani), Golden alexanders (Zizia aptera and Z. aurea), Fringed sage (Artemisia frigida), Sage (Artemisia caudata), Prairie sage (Artemisia ludoviciana), Purple prairie clover (Petalostemon purpureum), Ground plum (Physalis virginiana and P. heterophylla), and Showy milkweed (Asclepias speciosa).

Scattered shrubby growth was depicted all along the quartzite outcropping in Catlin's 1898 painting. A photograph of Indians digging the pipestone in the 1890's shows a shrubby ridge in the background with closely grazed prairie and patches of low shrubs which appear to be Buckbrush (Symphoricarpus occidentalis) (4). Photographs of Winnewissa Falls in the early 1900's show trees back from the edge, perhaps 20 feet high. Examination of a 6-inch diameter limb cut from a small storm-damaged bur oak (Quercus macrocarpa) along the trail revealed an age of 81 years. In other sites, particularly

above the falls, trees of bur oak and American elm (Ulmus americana) appeared much older; however, no attempt was made to determine their age. It is reasonable to assume that trees have been present for centuries in the quartzite outcrop partially protected from complete destruction by prairie fires in the past and greatly increasing in size and abundance since the fires have been prevented.

The same photographs and sketches that show woody growth on quartzite outcrops also show very short prairie grasses and forbs as if heavily grazed and trampled. It is reasonable to assume that the grazing impact of horses would have been locally severe after they were available to the Indians by the mid-17th Century. However, it is unlikely that the prairie was permanently damaged by grazing or by fire, since the prairie species evolved with adaptations to both.

## III. Management History

Management history of the monument is sketchy, but it would seem that prior to 1937 it would have been subjected at times to heavy grazing, camping, burning, and raising of crops. A railroad to the east and a roadway looping in from the south are visible in 1950 aerial photos. The westernmost 80 acres were cultivated from an unknown date until 1956 when they were included in the monument. Cropping is clearly visible in the 1950 aerial photograph. It also appears that portions were at times grazed by domestic livestock or mowed for hay. Mowing has been used also for weed control and general appearance maintenance.

A sketch of the monument is useful in describing units in more detail for management recommendations. Numbering of units follows notes and sketches provided by the maintenance superintendent. Prescribed burning was introduced in 1973 probably in response to the effects of a wildfire in 1971 which

burned southward along Pipestone Creek. Spring burning was used in 1973, 74, and 75 according to the breakdown of units:

Unit 1 - East portion burned in 1973, West portion burned in 1974 and 1975, with no burning inside circle trail.

2 - 1973

3 - 1974

4 - 1974

5 - 1974

6 - 1974

7 - 1975

8 - 1975

9 - Unburned

#### IV. Present Status of Prairie Vegetation

Detailed description of prairie species in each unit is not possible here; however, a general description is provided from our cursory examination of all units. Bluestem prairie vegetation predominates in units 1, 2, 7, 8, and eastern portions of 4, 5, and 6 with occasional patches of smooth brome (Bromus inermis) and other introduced species in response to old road beds, construction, and other soil disturbance. It approximates the original prairie except for the present abundance of woody plants such as Buckbrush, Smooth sumac (Rhus glabra), Wild black currant (Ribes americanum), Chokecherry (Prunus virginiana), American plum (Prunus americana), Western sand cherry (Prunus besseyi), Hackberry (Celtis occidentalis), Grey dogwood (Cornus racemosa), Green ash (Fraxinus pennsylvanica), Bur oak, Elm, and others. These woody plants would continue to spread as they have during the past 70 years of protection from fire, especially in the vicinity of Lake Hiawatha and Winnewissa Falls. Native species are well represented on the quartzite outcrops where extreme conditions of moisture and temperature are in force.



Introduced pasture species predominate in units 4, 5, and 6 and in portions of 3 and 9. Species such as Smooth brome, Kentucky blue grass (Poa pratensis), White and Yellow sweetclover (Melilotus alba and M. officinalis), Quackgrass (Agropyron repens), Canada thistle (Cirsium arvense), and Red clover (Trifolium pratense) are common. Native species are interspersed; occasionally dense patches of Wild strawberries (Fragaria virginiana), Prairie phlox, Prairie rose, Smooth aster, and other prairie species are found; usually more scattered individuals of these and other species prevail. The dominant tall prairie grasses are very sparse. Annual weeds and Sour dock (Rumex crispus) are abundant only where the sod has been recently disturbed along recently constructed sewer lines and the old railroad right-of-way. Seedling establishment of native prairie grasses along the sewer line was fair to excellent on the east side of the entrance road, and very poor on the west side.

In general the status of the native prairie vegetation is good to excellent. There are abundant species of tall grasses and forbs in vigorous condition of flowering and seed production. It is an excellent basis for maintenance of the area in accord with the objectives of the monument. There is no question but that the prairie has benefitted from recent burning.

#### V. Analysis of Management and Recommendations

Management of the vegetation must take into consideration the tendency for woody plants to spread and increase in size and for aggressive weeds such as Canada thistle to expand in areas of former soil disturbance. The maintenance program presently underway does this and is compatible with the objectives of the monument to encourage the original Bluestem Prairie vegetation. Prescribed burning is an effective means to reduce the vigor and gradually control the spread of woody plants in this climatic region; however, it alone is not effective in handling many of the weeds. Fire, although a natural

force, is a severe disturbance to which most prairie grasses and forbs are adapted. Their growth and seed production are often enhanced by the effects of burning during the dormant season. Without prairie species in the vegetation, however, fire accomplishes little permanent change because weeds can flourish following the fire unless restricted by competition from the better adapted prairie species. It is doubtful that Canada thistle and other aggressive weeds will invade vigorous prairie sod, and in contrast, it is doubtful that prairie species will completely replace Canada thistle, Smooth brome, Quackgrass, Kentucky bluegrass, and other pasture perennials where they are well established, at least in the next two or three decades. Maintenance which enhances the Bluestem Prairie species in the long run should be the preferred approach. Mowing of sweetclover patches and spraying of thistle can be a recurring event in response to weather patterns which encourage more vigorous growth in some years. The overall objective to maintain an appearance of original prairie is not lost while controlling unwanted species. A slow but sure return of the native prairie species is anticipated similar to the process of the past century of use. If the prairie was as closely grazed and trampled as is suggested in Catlin's 1836 sketch, it has, indeed, done well largely on its own.

Maintenance recommendations include:

1. Continue present maintenance program in general.
2. Establish a prescribed burning program to burn each unit once in four or five years except for those units where woody plants are abundant. These should be burned twice in consecutive years during the same time interval. Time of burning should be approximately first week of May.

3. Spot spraying of Canada thistle in the rosette stage with 2,4-D, Banvel or other locally prescribed chemicals is recommended. If patches escape spring treatment, they can be mowed in midsummer to reduce seed production and sprayed during the early fall when regrowth occurs. Spraying will be required for many years to accomplish complete control.
4. Mowing of sweet clover patches in units 4, 5, and 6, especially during wet years, is suggested. Mowing and spot-spraying of broadleaved weeds is suggested in recently planted areas of disturbance such as the sewer line and the abandoned railroad right-of-way. Because these are rather narrow strips it is expected that prairie species will fill in during the next few years.
5. Because of the scarcity of native prairie grasses in units 4, 5, and 6 it would be desirable to provide seed of the following species either as a drilling or scattering procedure following burning: Big bluestem, Indian grass, Little bluestem, Canada wild rye (Elymus canadensis), Switchgrass, Green needlegrass (Stipa viridula), Western wheat grass (Agropyron smithii), and other native grasses and forbs which may become available. Numerous forbs are already abundant in much of the area and would continue to spread. I would not consider plowing these units and starting all over. The view from the visitor center today gives the appearance of original prairie, a view which would not be much changed, for all practical purposes, even with the return of all original prairie species to the area.

6. Transplanting of certain prairie species of significant interpretive interest should be considered. Tipsin would be an especially good example which was not observed along the Circle Trail which certainly should be. A cultivated display of prairie species would be less desirable than continuing the excellent procedure of moveable signs along the trail. There is enough flexibility in the positioning of the trail that transplanting of species can be done several years in advance of swinging the trail by them. Transplanting can be done with best success during early spring and late fall when the ground is not frozen and the plants are dormant.
7. Continue to encourage identification and study of the native plants and animals of the monument.
8. Retain the characteristic trees and understory in the vicinity of Lake Hiawatha and Winnewissa Falls, but gradually stabilize a forest-prairie edge with the use of fire to expose more of the quartzite outcrop as is visible in the earliest photographs.
9. Establish photo stations at various critical points taken annually to help in making decisions on management by comparison with earlier photographs. Trends which develop contrary to management objectives can be more easily observed, and continuity can be strengthened as supervisory staff changes occur.

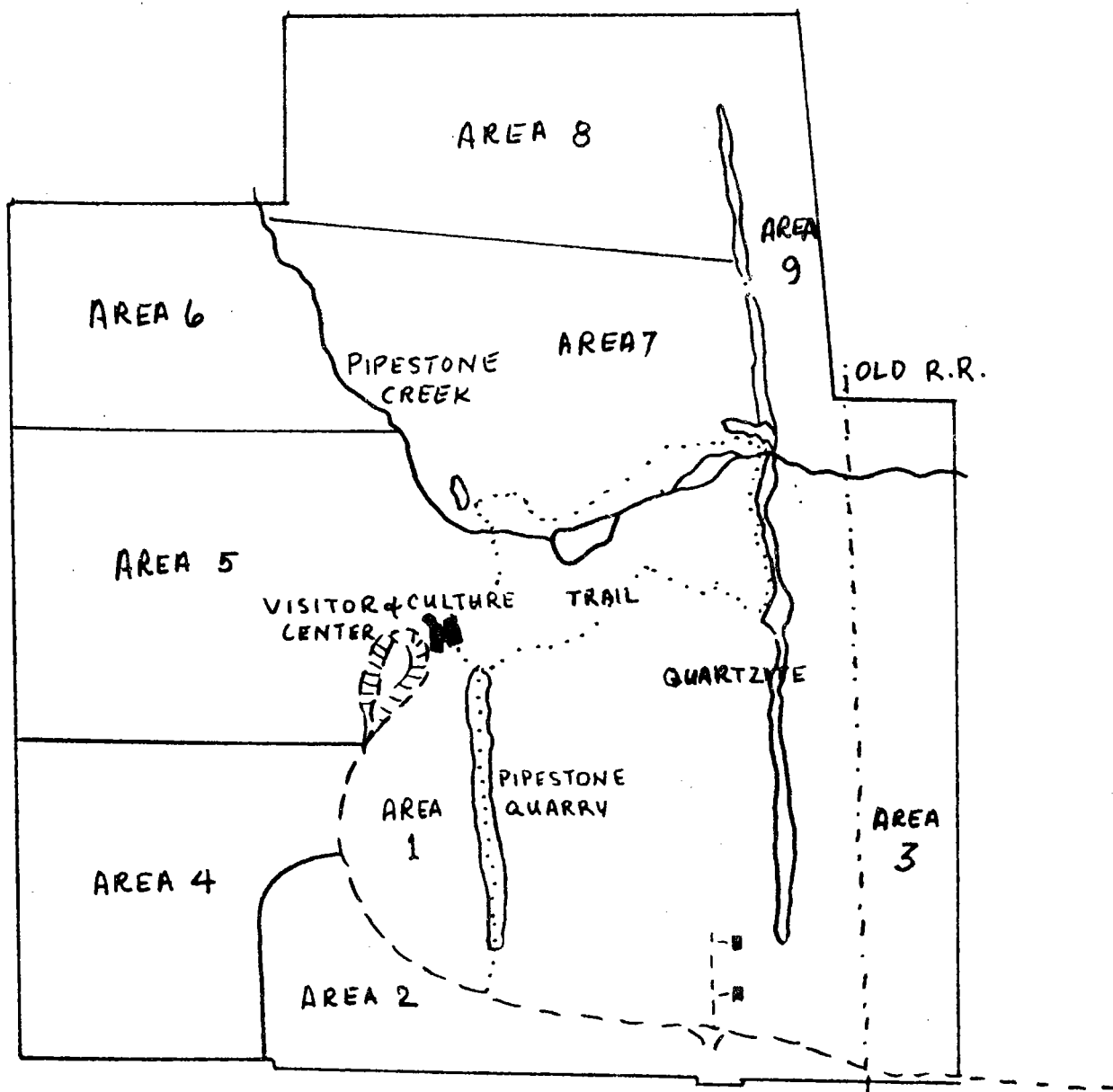
Additional information is needed to develop a comprehensive management program. Information on the extent of tree growth in earlier days can provide a better definition of the forest-prairie boundary which should be maintained. Tree-ring studies of cross-sections of dead material and corings of living

trees would provide the best information since photographs and sketches are not complete. Fire scars might be found which are dateable to show extent and severity of earlier fires.

Photographs made annually at designated stations would provide evidence in support of the management program or reveal trends which may be unfavorable. Modifications on prescribed burning intervals, for example, may be needed after the first decade of this program. Increase in certain shrub species might occur despite early success with the use of fire. Documentation of the actual maintenance activity would be essential to evaluate changes as revealed by photographs.

#### VI. Local References

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2. Soubier, Clifford. 1971. Pipestone - a guide through the Pipestone  
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3. Küchler, A. W. 1964. Potential Natural vegetation of the conterminous  
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No. 36. Manual to accompany the map.
4. Pipestone Indian Shrine Association. 1959. Circle Trail. booklet,  
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5. Moore, John W. 1956. A Provisional List of the Flowering Plants,  
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PIPESTONE NATIONAL MONUMENT  
Fig. 1

## Herbert Hoover National Historical Site

### I. Historical Setting

The Herbert Hoover National Historic Site was established on August 12, 1965, memorializing a period in history between 1874 and 1884 during the boyhood days of Herbert Hoover. "His life at West Branch, Hoover recalled, was 'filled with adventure and great undertakings, with participation in good and comforting things'" along the Wapsinonoc Creek (1). On the south edge of West Branch his boyhood home and many of the familiar buildings of that period have been restored.

Although the prairie was established as a maintenance feature rather than a characteristic of the immediate landscape during the boyhood days of Herbert Hoover, it should serve additionally in interpretation of the general environment in which he adventured.

### II. Natural History

Although it is probable that Bluestem Prairie once occupied the site before West Branch was established, it is likewise probable that the prairie had been transformed into farmland before the boyhood days of Herbert Hoover. Whether or not small remnants of prairie existed along the Wapsinonoc during the 10 years of his life there is debatable. The chances are a few species must have persisted such as goldenrod (Solidago spp.), slough grass (Spartina pectinata), cup plant (Silphium perfoliatum), and others.

The Bluestem Prairie, a dense vegetation of tall grasses and forbs occasionally to 10 feet high, once predominated in this region (2). Big bluestem (Andropogon gerardi), Little bluestem (Andropogon scoparius), Switchgrass (Panicum virgatum), and Indian grass (Sorghastrum nutans) are dominants with other components consisting of Leadplant (Amorpha canescens), Pussytoes (Antennaria neglecta), Little white aster (Aster ericoides), Smooth aster (Aster laevis), False indigo (Baptisia leucantha) and B. leucophaea, Side-

oats grama (Boutelous curtispindula), Daisy fleabane (Erigeron strigosus), Bedstraw (Galium sp.), Bigtooth sunflower (Helianthus grosseserratus), June grass (Koeleria cristata), Blazing star (Liatris aspera, L. punctata), Scribner's panic grass (Panicum scribnerianum), Prairie phlox (Phlox pilosa), Silverleaf scurfpea (Psoralea argophylla), Longheaded coneflower, (Ratibida columnifera), Yellow coneflower (Ratibida pinnata), Prairie rose (Rosa arkansana) Compass plant (Silphium laciniatum), Goldenrod (Solidago altissima and S. missouriensis), Stiff goldenrod (Solidago rigida), Prairie dropseed (Sporobolus heteralepis, and Porcupine grass (Stipa spartea).

Trees of any kind probably did not persist on this site until planted by the early residents. Once the prairie fires were restricted, trees such as willow (Salix spp.) and cottonwood (Populus deltoides) probably established naturally along the creek.

## 11. Management History

For ease of management, the large block of cultivated land consisting of about 76 acres to the south and west of the buildings and grave site was seeded to native prairie grasses in spring 1971. The mixture consisted of Big bluestem, Switchgrass, Indian grass, Little bluestem, and side-oats grama on 65 acres of higher ground and just the first three on the wetter areas. No prairie forbs were available for planting. Extensive annual weed growth occurred during the first growing season, so much so that in the northwest corner the prairie establishment was unsuccessful despite mowing in midsummer of rank pigweed and other broad leaved plants. The entire planting was mowed in midsummer of 1971 and burned in spring of 1972 to remove the accumulation of first year growth. No burning has been done since 1972. Mowing of fire lanes on the periphery, mowing along the east edge, and mowing the northeastern one-fifth of the prairie for parking and other needs were done



in 1974. Trees were planted immediately south of the grave site accompanied by close mowing of the grass cover.

## II. Status of the Prairie Planting

An excellent establishment of prairie grasses has occurred from the grave site south. Patches of annual weeds occur in drainage ways in three or four areas consisting of Smartweed (Polygonum pensylvanicum) and giant ragweed (Ambrosia trifida) and a few small patches of Canada thistle (Cirsium arvense) are found along the south fence. Extensive weedy cover extends eastward down the drainage from the farm on the western boundary to the lower ground northward. The prairie in the northwest one-fifth of the site, with the exception of the extreme corner, is more open, perhaps more disturbed from mowing, and is rather weedy. The competition from prairie grasses alone apparently is unable to restrict the abundance of many annual, biennial, and perennial broadleaved species. In the extreme northwest corner no survival of prairie species is evident.

Cursory observation indicates that the planted prairie grasses are maintaining dominance on slopes where soil has been lost to erosion while the weedy species dominate on sites of silt accumulation along drainage ways.

Organic debris from past growing seasons is accumulating in much of the prairie planting. Decreased vigor of prairie plants would occur with increased accumulation (3).

## V. Analysis of Management of Prairie Planting

It is surprising that more woody plant species have not established in areas where prairie grasses failed to dominate. Mowing or burning at intervals of three to four years may be necessary if woody invasion occurs or has been overlooked in this brief survey. The overriding problem, however, is

one of maintaining a vigorous enough mixture of prairie species to keep out the presently abundant herbaceous weeds. Spraying annually with 2,4-D and related compounds might be effective, yet unnecessarily expensive if, instead, additional prairie species can be established to increase the competitive mixture. How does one establish prairie forbs among well established grasses? . . . while controlling other broad-leaved plants? . . . on different soils? . . . and in what densities? Answers to these questions are needed before one can advise adequately on long term management.

In the meantime, the following management recommendations are given:

1. Spot spraying of Canada thistle with 2,4-D or Banvel should be done in the late spring during the rosette stage of the plant. If patches escape spring treatment, they can be mowed in midsummer to reduce seed production and sprayed during the early fall when regrowth occurs. Spraying will be required for many years to accomplish complete control.
2. Mowing or spraying of dense stands of giant ragweed by midsummer is necessary to reduce seed production and shading of prairie seedlings in the understory. Dense patches of smartweed could be similarly treated.
3. If burning is not feasible due to the proximity to West Branch and Interstate-80, the prairie should be mowed in early fall one year in four, and the hay removed.
4. Re-establish the northwest corner to pasture or prairie species compatible with the rest of the site.

Results of a study funded by the National Park Service on establishment of prairie forbs at this site will be available December 1977 for further recommendations.

## Ti. Local References

1. National Park Service. 1973. Herbert Hoover National Historic Site, Iowa. Brochure.
2. Kuchler, A. W. 1964. Potential Natural Vegetation of the conterminous United States. American Geographical Society Special Publication No. 36. Manual to accompany the map.
3. Aikman, John M. 1955. Burning in the management of Prairie in Iowa. Proceedings Iowa Academy of Science 62:53-62.

## Effigy Mounds National Monument

### I. History

The Effigy Mounds National Monument was established October 25, 1949 to preserve the earth mounds found in northeastern Iowa in the natural setting (1). It consists of 1467.5 acres in a North and South unit separated by Highway 76 and a detached unit, Sny-Magill, eleven miles to the south.

### II. Natural History of Area

The original vegetation of the Effigy Mounds area, including the time during which the mound building occurred, was Maple-Basswood Forest with scattered openings of Bluestem-Prairie on the extreme south facing hillsides and rocky bluffs. Despite early clearing of the more level upland sites for farming and a complete removal of the forest for lumber about the turn of the century, the level openings are rapidly returning to trees and most of the sloping ground has returned to dense forest cover. Prairie patches still remain on the points and severe south facing slopes, with scattered Chinkapin oak (Quercus muhlenbergii) and abundant Eastern red-cedar (Juniperus virginiana) established as old, often gnarled, trees along the bluff edges.

The Maple-Basswood Forest is dominated by Sugar maple (Acer saccharum) and Basswood (Tilia americana) with numerous other strong components including Boxelder (Acer negundo), Bitternut hickory (Carya cordiformis), Ash (Fraxinus pennsylvanica), Ironwood (Ostrya virginiana), Bur oak (Quercus macrocarpa), Red oak (Quercus rubra), American elm (Ulmus americana), and Slippery elm (Ulmus rubra) (2). Black maple (Acer nigrum) is abundant, but it is often included as a variety within the description of Sugar maple. Three additional species are important dominants in our forests, White oak (Quercus alba), Shagbark hickory (Carya ovata) and White ash (Fraxinus americana) perhaps because of the impact of logging so recently.

Fires seldom occurred with force enough to damage the forest; however, it easily swept up the prairie openings along the south-facing slopes and consumed trees on the ridges. Fire scars are evident on many of the old trees in the park, especially adjacent to the prairie openings and on the bluffs.

The Bluestem-Prairie dominants consist of Big bluestem (Andropogon gerardi), Little bluestem (Andropogon scoparius), Switchgrass (Panicum virgatum), and Indian grass (Sorghastrum nutans). Other components include . . . Leadplant (Amorpha canescens), Pussytoes (Antennaria neglecta), Little white aster (Aster ericoides), False indigo (Baptisia leucantha and B. leucophaea), Side-oats grama (Bouteloua curtipendula), Daisy fleabane (Erigeron strigosus), Bedstraw (Galium tinctorum), Big tooth sunflower (Helianthus grosseserratus), June grass (Koeleria cristata), Blazing star (Liatris aspera, L. punctata, and L. scarriosa), Scribner's panic grass (Panicum scribnerianum), Prairie phlox (Phlox pilosa), Silverleaf scurfpea (Psoralea argophylla), Long headed coneflower (Ratibida columnifera), Yellow coneflower (Ratibida pinnata), Prairie rose (Rosa arkansana), Compass plant (Silphium laciniatum), Goldenrod (Solidago altissima and S. missouriensis), Stiff goldenrod (Solidago rigida), Prairie dropseed (Sporobolus heterolepis), and Porcupine grass (Stipa spartea).

### III. Management History of Park

The level uplands in both the North and South units were farmed until the 1940's then allowed to revegetate on their own. Portions were grazed and mowed; however, no attempt is being made to keep these areas open at the present time. It is probable that the whole area was cut for timber by 1904 (3). Additional selective cutting probably occurred again before the park was established. The use of fire has not been part of the management program.

## 7. Status of Prairie Areas

The level uplands that were once cultivated are now a mixture of original prairie species, introduced pasture species, woody plants of the forest-prairie edge and scattered trees of the forest. The trend is to rapidly close-in with woody species as has occurred in the formerly grazed opening near the marching bears mounds in the South unit. Within another 20 years the closing-in would be complete in the South unit. The openings in the North unit are not closing in as rapidly; however, within 20 years there will be few areas without numerous small trees or dense shrubs. Another 50 to 100 years would need to pass before Sugar maple and Basswood dominance could be expected. Areas in the North unit along some of the trails are indicative of recent forest cover with the canopy dominated by Aspen (Populus grandidentata and P. tremuloides) young Elm, even Sumac (Rhus glabra and R. typhina) and Hawthorn (Crataegus spp.).

The prairie openings which exist along the bluffs and extreme slopes contain Indian grass, Little bluestem, Goldenrods, Bush clover (Lespedeza capitata), Tick trefoil (Desmodium spp.), Wild Strawberry (Fragaria virginiana), False boneset (Kuhnia eupatorioides), Wild bergamot (Monarda fistulosa), White aster (Aster sp.), Rough blazing star (Liatris asper), Yellow coneflower, Big bluestem, Porcupine grass, Lead plant, Thimble weed (Anemone cylindrica), Flowering spurge (Euphorbia corollata), Side oats grama, Canada blue grass (Poa compressa), Purple prairie clover, Tickseed (Coreopsis palmata), Bastard toad flax (Comandra umbellata), Prairie dropseed (Sporobolus heterolepis), Tall dropseed (Sporobolus asper), Prairie rose, Puccoon (Lithospermum canescens), Pussytoes (Antennaria plantaginifolia) and woody shrubs such as Ninebark (Physocarpus opulifolius), Service berry (Amelanchier arborea), Smooth sumac and often sprouts of the forest trees in addition to the ever present Eastern red-cedar. Most of the

points are too small to include more than 20 or so prairie species from the list; often human activity and natural erosion have damaged the precariously thin layers of soil that are present. Where woven wire fencing prevents human access to these prairie remnants there is relatively vigorous growth; however, the farthest point (Hanging Rock) has had enough human trampling to remove many square feet of prairie.

#### Analysis of Management

The management which is used should be determined by the long term objectives of Effigy Mounds National Monument. If the large openings are to be retained it will be necessary to mow or burn or do both to convert this to prairie instead of forest. If they are to return to forest it will accomplish this on its own if protected from accidental wildfire during the next 20 to 50 years.

The prairie openings along the bluffs must receive more protection if they are to survive. Clearing of shrubby growth not only provides a scenic view but removes severe competition which would shade out prairie species if allowed to grow. Under more natural conditions this would have been kept open by occasional lightning or human induced fires. It is recommended to allow fires to burn if started by lightning during the early spring until about May 15. At other times they should be extinguished rather than allowed to endanger the forest. During the early spring it is usually very difficult to sustain a fire in the forest; therefore, the prairie openings would burn and that's about all.

An interpretive program including more of the prairie plants would be desirable to coincide with the very excellent marker signs and information on forest species and earth mounds.

# **1. Local References**

- (1). National Park Service. 1973. Effigy Mounds National Monument.

Iowa. Brochure.

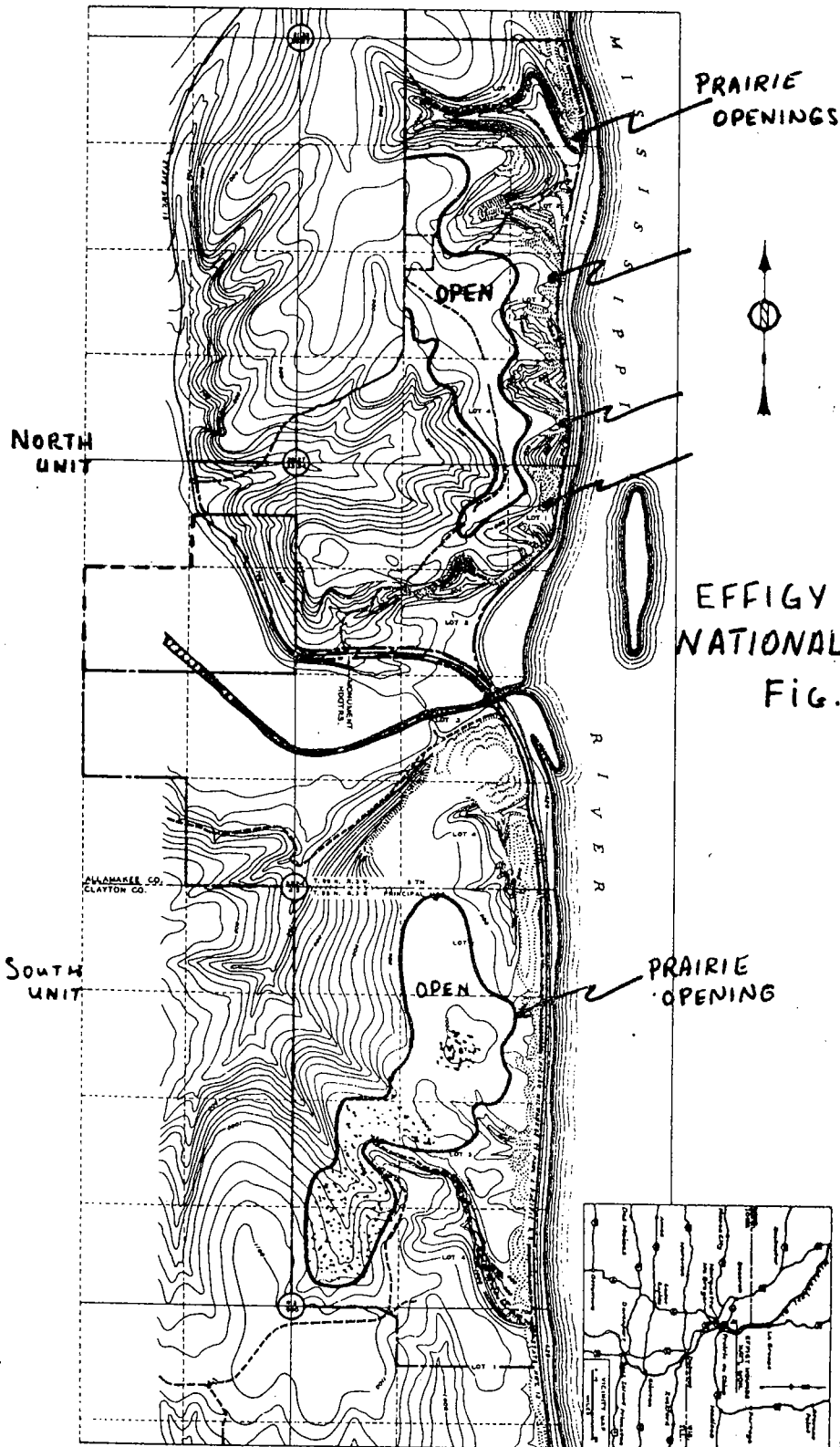
- (2). Kùchler, A. W. 1964. Potential Natural Vegetation of the Conterminous United States. American Geographical Society Special Publication No. 36. Manual to accompany the map.

- (3). Reinhardt, Bill. 1975. Personal interview on 29 August, 1975.



LEGEND

[Symbol]	Unimproved Roadway
[Symbol]	County Line
[Symbol]	Section Line
[Symbol]	1/4 Section Line
[Symbol]	Contours
[Symbol]	Highways
[Symbol]	Road - Wide Surface
[Symbol]	Road - Track Trail
[Symbol]	Road - Unimproved
[Symbol]	Foot Trail
[Symbol]	Marshes



EFFIGY MOUNDS  
NATIONAL MONUMENT  
FIG. 1

ALABAMA CO. CLAYTON CO.

## Homestead National Monument

### I. Historical Setting

Establishment of the Homestead National Monument was authorized by Congress in 1936 following several years of local activity to get the Daniel Freeman land so designated (1). The 160 acres of "unappropriated Government land" were made available to Daniel Freeman soon after filing on January 1, 1863 with his promise to live on the land and cultivate it for five years before becoming full owner. The two acres, one quarter mile to the northwest containing the brick school house, have recently been added to the monument.

### II. Natural History

The site of Daniel Freeman's homestead was part of "this great area of waving grasses, bedecked with wonderful flowers" which was called prairie by the early settlers (2). Here was the center of a vast grassland turning drier to the west and wetter to the east extending hundreds of miles in all directions. Along rivers and streams hardwood forests were able to survive in their abundance of ground water and slight protection from prairie fires. This is what Daniel Freeman found in all probability because the land survey made in 1857 reported approximately one-third of the area in timber (3). That timber is still present in roughly the same boundary along Cub Creek occupying approximately one-third of the 160 acres.

The prairie vegetation was undoubtedly typical Bluestem prairie, a dense vegetation of tall grasses and many forbs (4). Big bluestem (Andropogon gerardi), Little bluestem (Andropogon scoparius), Switchgrass (Panicum virgatum), and Indian grass (Sorghastrum nutans) are dominants with other components consisting of Leadplant (Amorpha canescens), Pussytoes (Antennaria

neglecta), Little white aster (Aster ericoides), False indigo (Baptisia leucantha and B. leucophaea), Side-oats grama (Bouteloua curtipendula, Daisy fleabane (Erigeron strigosus), Bedstraw (Galium tinctorum), Big tooth sunflower (Helianthus grosseserratus), June grass (Koeleria cristata), Blazing star (Liatris aspera, L. punctata, and L. scarriosa), Scribner's panic grass (Panicum scribnerianum), Prairie phlox (Phlox pilosa), Silver-leaf scurfpea (Psoralea argophylla), Long headed coneflower (Ratibida columnifera), Yellow coneflower (Ratibida pinnata), Prairie rose (Rosa arkansana), Compass plant (Silphium laciniatum), Goldenrod (Solidago altissima and S. missouriensis), Stiff goldenrod (Solidago rigida), Prairie dropseed (Sporobolus heterolepis), and Porcupine grass (Stipa spartea). Many of the above species were observed in the area.

It is not known what intensity and to what boundary with the wooded stream the course of cultivation took; however, it is known that most of the area was cultivated until the early 1930's (5). Rows straight up and down the slope and water from adjacent land created severe erosion on some portions. Although poor drainage has always been a problem in the flat areas, the silting that occurred from this early erosion probably has increased the problem. The last cultivation was in 1937 at which time it was seeded to a mixture of prairie species.

### III. Management History of the Monument

Very few details were assembled concerning the early establishment of prairie following the first plantings. A "good establishment" was obtained from the 1937 planting, and some prairie sod was brought in to use on the severely eroded spots (5). Correspondence and comments in the superintendents file are indicative of a steady recovery. The following are excerpts from these notes:

1. Cutting of prairie hay in 1953 on contract with W. F. Thimm, Beatrice yielded 3207 bales averaging 57 pounds per bale for a total price of \$567.59.
2. Harvesting of Little bluestem seed in 1954 from all but the erosive S corner yielded 550 pounds.
3. Mowing for hay in 1955 rather than spraying to control weeds was done about 10 acres in the southwest 40. Commenting on management in 1955 Agronomist L. G. Wolfe stated that scattered sweet clover growing in native grass area could develop into a serious weed problem. Spraying was suggested, but the regional chief of operations did not say that had been done. Commenting on conditions in 1956, Regional Soil Conservationist Fred Dickison complimented the monument on the remarkable record of the land in recent years. Some weed problems were mentioned, especially thistle (Bull thistle, Canada thistle) Ragweed, Horse nettle, and Bindweed. Responding in 1957 on weed control, Superintendent R. K. Shover stated "we are in the process of spraying the young elm and weeds in the prairie using a hand spray. As soon as this is completed, we will try the aminotriazole . . . [to control] Canadian thistle."
4. Cutting of prairie hay was contracted in 1965 for no fee which called for mowing the entire prairie except for SE corner. Restrictions included "That a new path be used each time a vehicle enters the prairie and depart from the prairie. #6 That in the event of rain, all equipment be removed off the prairie until determined dry by the superintendent. #8 That all hay be removed within ten days after cutting."

Haying was probably effective in reducing woody plant invasion and in controlling weeds. Mowing was done every two or three years late in the

season to let seeds mature. Except for 1965 about the last time the whole area was mowed for hay was 1953 (5).

Few photographs which document any aspect of the recovery were seen; however, photograph #106 of the Freeman cabin in 1948 shows little indication of woody plants in the prairie view. An earlier photograph (#1065) in 1942 shows part of the osage orange fence to the south with no woody plants in the prairie. However, it can be deceiving because photograph #1435 of the osage orange fence with prairie rose in the foreground shows little sign of woody plant growth in 1969, yet the whole area was burned in 1970 to control woody plant invasion and to remove the accumulation of prairie "thatch". The 70 acres of prairie south of the old highway route were burned according to plan on April 24, 1970. Approximately "70-75% of the juniper trees were destroyed" (6). Subsequently, vigorous sprouting of other woody plants in the area occurred suggesting one burn is not very effective against most of the hardwoods.

More recent plantings of prairie species were made in the 10 acres near the bridge where Smooth brome (Bromus inermis) and weeds dominated. In 1966 Regional Soil Conservationist, Fred Dickison suggested plowing it before planting prairie; however, for 1967 and 1968 special use permits were obtained for mowing it instead to control weeds. Planting was accomplished in 1969 with a mixture of prairie dominants including Big bluestem, Indian grass, Switchgrass.

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Portions remained weedy until 1975 when it was decided to plow under the weeds and replant.

## V. Status of Prairie

The prairie can be separated into three general areas: the recent planting of about 10 acres near the footbridge, the remainder of the level open ground adjacent to the recent planting and wooded edge of the creek, and the slopes to the south.

The recent planting shows Switchgrass, Big bluestem and other tall prairie grasses as vigorous clumps with spaces in between occupied by Prickly lettuce (Lactuca scariola), Bedstraw (Galium sp.), Common milkweed (Asclepias syriaca), Nettle (Urtica dioica), Smooth brome, Bluegrass (Poa pratensis) and others. One reason for the weediness is the excess moisture and poor drainage of the site. On higher, well drained ground to the south, Goldenrod (Solidago spp.) and Little bluestem are well established.

The level open ground is dominated with smooth brome and in many spots an abundance of young growth of woody plants. There are many native prairie species in this area including Big bluestem, Licorice root (Glycyrrhiza lepidota) and Prairie rose (Rosa arkansana) in abundance, with Little bluestem, Switchgrass, Canada wildrye, Bush clover (Lespedeza capitata), Goldenrods, Milkweeds, Sloughgrass (Spartina pectinata), and many others in lesser amounts. Native shrubs of plum (Prunus spp.) Dogwood (Cornus spp.) and Coralberry (Symphoricarpus orbiculatus) occur in expanding clusters with vigorously growing Elm (Ulmus spp.), Green ash (Fraxinus pennsylvanicus), Mulberry (Morus alba), Box elder (Acer negundo) and Honey locust (Gleditsia triacanthos) the most common small trees.

On the slopes to the south is the best example of prairie. Clusters of Lead plant (Amorpha canescens) follow the drainage routes into a matrix of Little bluestem, Big bluestem, Canada wild rye, and other grasses with typical prairie forbs such as Prairie rose, Whorled milkweed (Asclepias verticillata),

Prairie clovers (Petalostemon spp.), Goldenrod, Scurfpea (Psoralea tenuifolia) and Ground plums (Physalis spp.). The mixture appears in places as if it had never been cultivated. It is an excellent example of prairie restoration to approximate the original.

With the exception of the woody plants and the abundance of weedy species in the most recent planting, there does not appear to be any problem areas that would require spraying or mowing except for cosmetic effects. No Canada thistles were observed despite the concern expressed more than 19 years ago of their spread.

The two acres of original prairie sod by the schoolhouse support many native prairie species despite close mowing and other disturbance which has encouraged extensive establishment of smooth brome, especially around the fence, and Kentucky bluegrass. Porcupine grass (Stipa spartea), Big blue-stem, and Scribners panic grass (Panicum scribnerianum) are abundant along with Leadplant and Blue sage (Salvia azurea). Other forbs include White prairie clover (Petalostemon candidum), Yarrow (Achillea lanulosa), Big tooth sunflower (Helianthus grosseserratus), Ironweed (Vernonia fasciculata), Whorled and Sullivants milkweed (Asclepias sullivantii), Prairie rose, and Birdsfoot mallow (Callirhoe alcaeoides). Around the building there is much disturbance from construction activity and consequently many weedy species. Downy brome (Bromus tectorum), Dandelion (Taraxacum officinale), Smooth dock (Rumex sp.) Bind weed (Convolvulus sp.), Squirrel tail (Hordeum jubatum), Pigweed (Amaranthus retroflexus) are among them.

#### V. Analysis of Management

Among the prairie areas in National Park Service lands in the Midwest Region, the prairie slope to the south is the best example of prairie restoration. It also appears to be the oldest, perhaps the oldest in the nation. Whether it has been the management or the passage of time or both, it is a good

example to follow. The woody invasion is a natural process in this region, due in part to a recent decade or two of higher than average rainfall and the difficulties of mowing when the hay is not wanted and of burning when experienced personnel are not handy. The abundance of weed species in the most recent planting may be a temporary distraction, also due in part to above average rainfall. The following recommendations are in order:

1. Continue the program of prescribed burning for the prairie. It is not suggested that the whole unit be burned in any one year. Instead, the slopes to the south might be burned no more often than once in four or five years while the lower ground might be burned twice that often, occasionally two years in a row to more effectively control woody plant growth. An alternative to the use of fire would be mechanical or chemical control, but the disturbance of equipment and chemicals may encourage other weed problems.

Specifications provided by the Soil Conservation Service as referred to in the notes of the 1970 burn (6) are adequate for this procedure. Because the prairie plants recovering from a burn will not be subjected to grazing stress, it is unnecessary to adhere to item IV. B. 10, which restricts burning to once in three years.

The mowing of fire lines is recommended; however, in contrast with the 1970 burn procedure, I would not recommend plowing an outer line. Despite the added protection against escape of the fire, it creates a potential site for weed invasion that could bring on more trouble. Usually, burning with the ground wet and the loose material in the mowed lane raked up is an adequate precaution against escape of the fire.



2. The 1969 planting may be a difficult area to bring into a stabilized prairie community with the present species if moisture remains high. Drainage has changed since the land was first settled because of siltation so that some areas once supporting prairie species may now more properly support wet prairie or marsh species. The addition of seeds of Reed canary grass (Phalaris arundinacea) and sprigs of Prairie cordgrass (Spartina pectinata) to the mixture would be one alternative; however, they tend to form rather dense single species colonies as they spread out vegetatively into suitable areas to the exclusion of other prairie species. A more expensive procedure would be to install tile drainage as has been done in agricultural land under similar circumstances.
3. Continue the attractive display of native plants along the trail. Keep a constant check on mislabeled or invading sprouts from other plants. For example, orchard grass (Dactylis glomerata), a European pasture grass occupied two of the three pots designated Reed canary grass, and the Heath Aster is probably New England aster, instead. This display is preferred over labelling plants along the trail unless very close surveillance is given to prevent vandalism, but you have more experience at this than I do.
4. Weed problems may appear for a number of years at the school house because of the disturbance. Close and regular mowing would probably result in a rather adequate bluegrass lawn near the building; however, I would urge you to mow the remainder of the schoolground no more than once a year preferably in the fall after frost. There is an adequate sprinkling of prairie plants to provide a rather attractive original remnant if it is carefully protected. Spraying with 2,4-D to control broadleaved weeds, if done, should be limited to the one-fourth of the school ground nearest the highway.

5. Establish photo stations to help document changes in the vegetation of the area. It is unfortunate that better records were not kept on the early establishment of the prairie. It could have provided much needed information for further establishment in midwest parks and other areas.
6. Establish a collection of plants and animals from the area to be used in interpretive programs that may be becoming more in demand. Take advantage of summer personnel with experience in handling of specimen material.

#### VI. Local References

- (1) National Park Service. 1973. Homestead National Monument. Nebraska. Brochure.
- (2) Weaver, J. E. 1954. North American Prairie. Johnsen Publishing Co. Lincoln. 348 pp.
- (3) National Park Service. 1961. The Master Plan for preservation and use of Homestead.
- (4) Kuchler, A. W. 1964. Potential Natural Vegetation of the conterminous United States. American Geographical Society Special Publication No. 36. Manual to accompany the map.
- (5) Clifford, William R. 1975. Personal interview on June 3, 1975. Beatrice, Nebraska.
- (6) Homestead National Monument. 1970. Memorandum D54 to Director, Midwest Region from Superintendent, Homestead. June 4.



## Scotts Bluff and Agate Fossil Beds

### I. Historical Setting

"The North Platte Valley, of which Scotts Bluff is the dominant natural feature, has been a human migration corridor for centuries." (1). The first white men saw this massive landmark in 1812, but the naming was derived from a fur trader, Hiram Scott, who died in the vicinity in 1828. By 1843 a large migration of people toward Oregon was occurring and in 1848 more than 150,000 people traveled through the area. Pony Express, transcontinental telegraph lines, stage lines, eventually in 1869 railroads came in, marking the decline of the Oregon Trail. By 1885 the first homesteaders had arrived in the North Platte Valley. Soon after the turn of the century the Agate Fossil Beds became a center of activity of a different sort (2). Extensive scientific excavations continued from 1904 until 1950, but it was not until June 5, 1965 that the Agate Fossil Beds National Monument was established. Consisting of approximately 1970 acres of open landscape and fossil outcrops along the Niobrara River, this monument saw little of the human activity crossing through as at Scotts Bluff. Scotts Bluff National Monument consists of approximately 3060 acres more or less bisected by Nebraska state highway 92. It was established December 12, 1919.

### II. Natural History

Because Scotts Bluff rises 800 feet above the valley floor with differing geological substrates for plant development, the vegetation consists of at least three groupings. The moderately dense, short or medium tall grassland, designated Wheatgrass-Needlegrass (3), occurs on the less eroded summits and gently sloping terraces at lower elevations. Components of the Eastern Ponderosa Forest occupy more eroded positions on the summit and steep sheltered slopes usually facing north, northeast, or northwest. The large remainder of

the area on the slopes is a mixture of shrubby and herbaceous plants, designated as Sage-Bluestem Prairie. There is a complex overlapping of species in the three categories, making it rather impossible to characterize discrete boundaries.

Vegetation at Agate Fossil Beds consists mainly of the Wheatgrass-Needlegrass Prairie with a narrow strip of open floodplain meadow along the Niobrara River. Occasional Yucca and skunkbush along the rocky outcrops relate to the very abundant representatives of the Sage-Bluestem Prairie at Scotts Bluff.

The Wheatgrass-Needlegrass prairie consists of Western wheatgrass (Agropyron smithii), Blue grama (Bouteloua gracilis), Needle-and thread (Stipa comata), and Green needlegrass (Stipa viridula) as dominants. Other components are Slender wheatgrass (Agropyron trachycaulum), Pussytoes (Antennaria spp.), Fringed sage (Artemesia frigida), Sedges (Carex spp.), June grass (Koeleria cristata), Sand lily (Mentzelia decapetala), Indian ricegrass (Oryzopsis hymenoides), Penstemons (Penstemon spp.), Little bluestem (Andropogon scoparius), Heath aster (Aster ericoides), Purple coneflower (Echinacea angustifolia), Blazing star (Liatris punctata), Silverleaf scurfpea (Psoralea argophylla), Goldenrods (Solidago spp.), and Porcupine grass (Stipa spartea) (4).

The Sage-Bluestem Prairie is a medium tall, medium dense grassland with a strong element of dwarf shrubs. The dominants consist of Little bluestem, Sand bluestem (Andropogon hallii), Sandsage or Fringed sage (Artemesia filifolia or A. frigida), and Hairy grama (Boutelous hirsuta). Other components are Blue grama (which is more pronounced in this area than hairy grama), Buffalo grass (Buchlœe dactyloides), Prairie sandreed (Calamovilfa longifolia), Lovegrass (Eragrostis trichodes), Sunflower (Helianthus petiolaris), Squirrel tail (Hordeum jubatum), Switchgrass (Panicum virgatum), Sand dropseed (Sporobolus crypandrus), Needle-and thread, and Yucca (Yucca glauca). Skunkbush (Rhus trilobata), Coralberry (Symphoricarpos orbiculatus), Buffaloberry

(Shepherdia argentea), Currants (Ribes spp.), Chokecherry (Prunus virginiana), and Mountain-mahogany (Cercocarpus betuloides) are commonly occurring shrub species (5).

The Eastern Ponderosa Pine Forest type is described as a medium dense to open forest of low to medium tall needleleaf evergreen trees with a fairly open ground cover of grasses. Ponderosa pine (Pinus ponderosa) dominates with understory components of Western wheatgrass, Blue grama, and Needle-and-thread. Rocky mountain juniper (Juniperus scopulorum) is more abundant in this area than pine at the present time.

Grazing by native animals and fire undoubtedly were important in their effects upon the vegetation of this region. In the vicinity of Scotts Bluff more so than at Agate Fossil Beds, people in large numbers passing through during the 19th Century needed grazing for their livestock and wood for their fires and constructions. The extent to which the open forest of Scotts Bluff was decimated during this time is unknown; however, it is unlikely that anything but open grassland covered the land at Agate Fossil Beds in recent times. By 1880, "Scotts Bluff was the geographical center of the open-range cattle industry..." (1), and cattle grazing persisted on Scotts Bluff perhaps well after establishment in 1919. It was reopened temporarily during World War II for grazing, and on Agate Fossil Beds grazing occurred until very recently except for small portions which are still grazed. The intensity of grazing is not known for either Scotts Bluff or Agate Fossil Beds; however, it is probable that some readily accessible areas were heavily grazed and other areas, inaccessible and far from water, were very lightly grazed by livestock.

Aerial photographs of Scotts Bluff approximately in 1939 show trees on the summit, but scattered and rather small ones elsewhere. More recent photographs in 1965 show additional trees yet fewer and smaller trees than are present today.

On the north and east facing slopes of the south unit, Rocky mountain juniper is common in the washes with Mountain mahogany, and the Ponderosa pine is on higher and steeper sites. Stumps and stump fragments of trees removed many years ago are scattered through the area. A juniper stump measured one foot in diameter alongside a living tree about the same size. Badly decayed pine stumps suggested trees extended further down the slope in times past. Similar conditions were not observed on the north unit; however, at least two stumps, presumably of juniper, were observed from the trail leading down from the summit.

### III. Management History

The management history of Scotts Bluff is rather complex; however, excellent photographic and written documentation of many activities was kept until the past several years. Tree planting and erosion control procedures predominated, beginning as early as 1933 with CCC people continuing into the late 1930's. Activity increased in the early 1950's with planting of Rocky Mountain juniper, Eastern red-cedar (Juniperus virginiana) and ponderosa pine, seeding over and planting a golf course and rifle range in the south unit; grass seeding and paving of trails on the summit, closing off and seeding to native species the lower portion of the zig-zag trail, and extensive reseeding and planting operations on other slopes in the north unit utilizing hay mulch lowered by individual bales over the summit edge. Additional planting of trees and erosion control plantings continued from 1963-1965 in the Scotts spring and other areas. The final round of reseeding started in April 1972 on 40 acres to the northwest near the Morrison farm with a mixture of Blue grama, Green needlegrass, Side oats grama, Little bluestem, and Western wheatgrass. The 32 acres planted November 1974 nearby was the most recent planting.

Prescribed burning, mowing, and grazing have not been used in maintaining prairie vegetation of Scotts Bluff at least in recent years. Accidental fires occurred along the northwest and north edges in 1975, and it is not recorded how often lightning and accidental fires started in areas near the bluffs. Spraying of Canada thistle (Cirsium arvense) has been done on a spot treatment basis at irregular intervals until this summer when removal of seed heads was done by hand in one small patch near the visitor center and extensive patches in the badlands and North Platte River upper floodplain.

Management history of Agate Fossil Beds could probably be described as typical ranching operations until areas were fenced off in recent years. The Hoffman ranch has localized areas of cultivation and heavy livestock use and trampling in the vicinity of the ranch buildings and some history of haying in the river meadows. Alfalfa plantings in the upper floodplain are still evident in the upper end of the Hoffman ranch and across the Niobrara River.

#### IV. Status of Prairie

Without exception, the slopes and summits of Scotts Bluff are in excellent condition of native species. Seed production appeared heavy in such important species as Yucca, Needle-and-thread, Green needlegrass, Sand bluestem, Prairie sandreed, Side oats grama, and Blue grama. Trees and shrubs are slowly increasing on the steeper slopes, and patches of skunkbush, coralberry, and other shrubs seem to be spreading at lower slopes. In neither situation does there seem to be a problem with deterioration of nearby herbaceous plants.

The 40-acre planting made in 1972 is excellent in spots with Blue grama, Side-oats grama, and Little bluestem most abundant with Green needlegrass and Western wheatgrass less dense. In spots Downy brome (Bromus tectorum), less often Japanese brome (B. japonicus), completely dominated the vegetation. Annual sunflower often was abundant in patches also. Downy brome occurred to some extent in native needlegrass, Yucca, Sage, and Prairie sand



reed in the vicinity of the old field fence. A stand of crested wheatgrass (Agropyron desertorum) adjacent to the mixed prairie planting appears to be well established and rather a pure stand. A few native species were observed coming in such as Indian ricegrass, Needle-and-thread, and Green needlegrass. Bindweed (Convolvulus sp.) and downy brome appear in spots to interfere with proper establishment of the desirable species.

The 32-acre planting appears to be solid fireweed (Kochia scoparia). One desirable grass seedling per 100 square feet was hard to find. Scattered alfalfa (Medicago saliva) and Smooth brome (Bromus inermis) were present except on the poorest site at the crest of the knoll where even fireweed was doing poorly.

With the exception of patches of Canada thistle on moist ground where canal water or flooding had occurred, the badlands north to the river including the former CCC camp were covered with native species. Effects of burning from the railroad were undetectable or else beneficial in promoting dominance of the prairie grasses and forbs. Heavy Canada thistle infestation in the Environmental Study Area suggests weakened native vegetation. A real problem exists here in an effective method of control.

Without exception, the vegetation of the Agate Fossil Beds in the vicinity of the headquarters is in excellent condition. Plants inside the recently constructed fence are slightly taller, denser, and with more seed than those grazed outside the fence. A good cover of Needle-and-thread, Blue grama, Sedge, Slender wheatgrass, Prairie sandreed, Indian ricegrass, Skeleton-weed (Lygodesmia juncea) and Fringed sage is occasionally broken by a patch of Downy brome, Sunflower, and Rocky Mountain bee plant (Cleome serrulata) in animal burrowing areas. The old road is healing over with fringed sage, Indian ricegrass, Sand dropseed, Slender wheatgrass, Sweet clover (Melilotus spp.), Downy brome, and many other species.

Upland sites are in rather stabilized prairie cover; however, in the flood plain of the Niobrara and some higher flatland where cultivation has occurred in the past, there are a number of weedy species which usually are of no consequence. Scattered Flodman thistle (Cirsium flodmani) and Platte thistle (C. plattensis) occur in the dense meadow vegetation. Near the buildings of the Hoffman ranch Flodman thistle is extremely abundant with fireweed, Western wheatgrass, Quackgrass (Agropyron repens), Kentucky bluegrass (Poa pratensis), and Maple leaf Chenopodium (Chenopodium sp.). Yet nearby upland sites are similar to the typical wheatgrass-needlegrass vegetation near the headquarters. Upstream on the Hoffman ranch the weedy character persists on the upper flood plain areas with a combination of fire weed, alfalfa, downy brome, needle-and-thread, horsetail (Equisetum spp.), and Maple leaf chenopodium on sites of former haystacks.

The construction of water storage facilities and lines near the headquarters has resulted in destruction of native plants mainly on the summit and down the slope along the water line. The disturbance should be of little consequence in the long term stability of this vegetation.

#### V. Analysis of Management.

The present management programs for Scotts Bluff and Agate Fossil Beds are in harmony with the overall objective of enhancement of original vegetation of the sites. Excellent local seed sources of the native prairie species are available on both areas. Despite the extreme natural erosion which is characteristic of Scotts Bluff, there is evidence that considerable healing over has been accomplished. Management of the major portion of Scotts Bluff should continue as one simply of letting it along. Planting of trees, once a high priority item, should not be considered very important at this stage. The

major effort should be directed toward the newly acquired areas around the edges, the control of noxious weedy species, and the healing over of unauthorized trails created by visitor use.

Specific recommendations on Scotts Bluff management include:

1. As areas become available, continue reseeding with mixtures of native grasses as has been accomplished in the 40-acre planting in 1972. In addition to the five species used before, Prairie sandreed and Sand bluestem should be added in small quantities to the mixture.

2. A procedure for collecting seeds of selected species should be established to take advantage of local seed production during good years. Yucca, for example, has a bumper crop of seed this year. Other showy species such as Purple coneflower, Prairie clover, Penstemons, and others can be collected over a long period of time in late summer and fall, but some such as Phlox, Goldenrods, Blazing star, must be collected almost as soon as the seeds ripen or they shatter. Seeds could be added to areas being planted to grasses either during the grass seeding operation or after establishment. They should be added to the 40-acre planting and Crested wheatgrass planting nearby.

3. The use of fire can be effective in temporarily controlling downy brome where there are seedlings or mature plants of prairie species. A late spring burn of small areas should be attempted in the 40-acre plot to gain experience in the use of fire in management of the first few years of a seeding.

4. The use of fire is not recommended for the steeper slopes and summit of the monument; however, lightning fires unquestionably are a natural part of this vegetation, and only temporary damage would result, except for the loss of small shrubs and trees which do not have the capacity to resprout.

Fires occurring naturally in remote areas could be allowed to burn as far as the prairie species are concerned. Rocky Mountain juniper, Eastern red-cedar, and Ponderosa pine usually do not survive severe scorching; however, most of the shrubs do such as Chokecherry, Coralberry, Skunkbrush, and Currant.

5. Spot-spraying for Canada thistle and other noxious weeds should be continued as needed. Spraying with 2,4-D in the spring during early growth can be effective over a period of several years. Weedy areas which escape detection until midsummer should be mowed to reduce seed production and sprayed with 2,4-D (Amine formulation) or Banvel in the fall after there is some regrowth. Neither of these chemicals have much effect on grasses, but they would damage other broad-leaved plants.

6. Re-establish photo stations which can be used to compare vegetation changes with earlier photographs. The extensive photographic and descriptive documentation in the 1930's and 1950's should be repaired and used as the basis for new photostations. Annual photographs would provide substantial information for long term management decisions.

Specific recommendations on Agate Fossil Beds management include the following:

1. Continue the present minimum management program of moderate grazing on the unfenced portions and no grazing on the fenced portions.
2. Reseeding following the construction of the water storage facilities seems unnecessary because of the availability of local seed sources.
3. Reseeding of the Hoffman ranch headquarters area should be done when the buildings and fences are removed with a mixture of Western wheatgrass, prairie sandreed, Slender wheatgrass, Blue grama, Green needlegrass in a ratio of pure live seeds (PLS) of about 1:2:1:1:1 for these species at the rate you have used at Scotts Bluff. The thistles in the area are a native species which can be mowed to control or left alone to a gradual reduction by

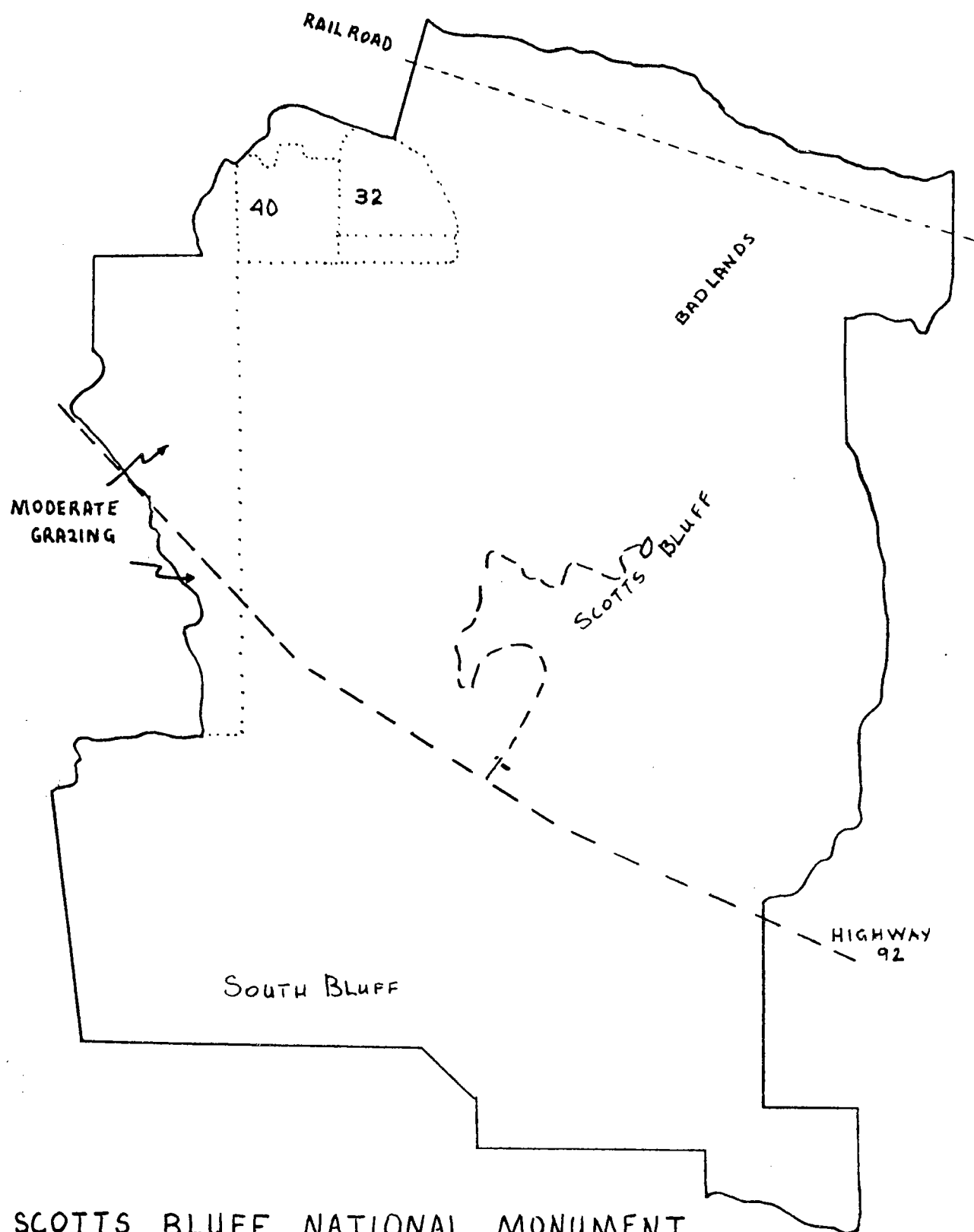
competition from other plants. Close mowing at regular intervals would favor the Kentucky bluegrass which is present in this area if a picnic area is desired.

4. A general hands-off policy would be the best management for the area in general because of the widespread coverage of rather stabilized native vegetation.

Additional information on prairie species is needed for Scotts Bluff, as well as Agate Fossil Beds. A collection and identification herbarium of all plants of the area should be established. It is essential for accuracy and convenience of the nature interpretive program which is apt to continue to increase in importance.

## II. Local References

1. National Park Service. 1974. Scotts Bluff National Monument. Nebraska. Brochure.
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3. Kijchler, A. W. 1964. Potential Natural Vegetation of the conterminous United States. American Geographical Society Special Publication No. 36. Manual to accompany the map.
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SCOTTS BLUFF NATIONAL MONUMENT

FIG. 1

## Fort Larned National Historic Site

### I. Historical Setting

"In the early 1860's Fort Larned was the northern anchor of the line of forts that defined the southwestern military frontier. It was first charged with protecting the mail and travelers on the eastern segment of the Santa Fe Trail, and afterwards served as a base for military operations against hostile Indians of the central plains (1). By 1878 the fort was abandoned and in 1884 the buildings and land were sold at public auction, remaining in private ownership until August 1964 when Fort Larned became a National Historic Site. There are 300 acres of land in the main unit around Fort Larned and 40 acres a few miles SW containing tracks of the Santa Fe Trail.

### II. Natural History

The original vegetation of the Fort Larned site would have been Bluestem-Grama Prairie on higher ground consisting of dense communities of grasses and forbs, often with two distinct layers, one of low-growing grasses and one of medium tall grasses and forbs (2). Dominant species include Big Bluestem (Andropogon gerardi), Little bluestem (Andropogon scoparius), Side oats grama (Bouteloua curtipendula), and Blue grama (Bouteloua gracilis). Other characteristic components are Western wheatgrass (Agropyron smithii), Western ragweed (Ambrosia psilostachya), Leadplant (Amorpha canescens), Purple three awn (Aristida purpurea), Butterfly milkweed (Asclepias tuberosa), Hairy grama (Bouteloua hirsuta), Buffalo grass (Buchloë dactyloides), Leather flower (Clematis fremontii), Dalea (Dalea enneandra), Purple cone-flower (Echinacea angustifolia), Canada wild rye (Elymus canadensis), Western wallflower (Erysimum asperum), Grassleaf penny royal (Hedeoma hispida), Junegrass (Koeleria cristata), Blazing star (Liatris punctata), Puccoon



(Lithospermum incisum), Evening primrose (Oenothera serrulata), Scribner's panic grass (Panicum scribnerianum), Switchgrass (Panicum virgatum), Chickweed (Paronychia jamesii), Many-flowered scurfpea (Psoralea tenuifolia), Scullcap (Scutellaria resinosa), Indian grass (Sorghastrum nutans), Tall dropseed (Sporobolus asper), and (Stenosiphon linifolius).

Immediately next to the Pawnee River and in poorly drained flat areas and flood plains the Floodplain Forest and Savanna (including Freshwater Marsh) vegetation type would have been prominent originally (2). This vegetation consists of tall, medium tall, and low broadleaf deciduous trees and shrubs. The ground is covered with an impoverished version of the Bluestem Prairie creating a Savanna effect. However, the prairie is suppressed wherever the woody plants form dense groves. The dominant species include Hackberry (Celtis occidentalis), Cottonwood (Populus deltoides), Peachleafed willow (Salix amygdaloides), Black willow (Salix nigra), and American elm (Ulmus americana). Other characteristic components include Boxelder (Acer negundo), Soft maple (Acer saccharinum), Beggar-ticks (Bidens polylepis), Canada wild rye (Elymus canadensis), White ash (Fraxinus americana), Green ash (Fraxinus pennsylvanica), Honey locust (Gleditsia triacanthos), Kentucky coffee tree (Gymnocladus dioica), Black walnut (Juglans nigra), Sunflower (Helianthus annuus), Red mulberry (Morus rubra), Virginia creeper (Parthenocissus quinquefolia), Wild blue phlox (Phlox divaricata), Sycamore (Platanus occidentalis), Smartweeds (Polygonum bicornis, P. lapathifolium, P. persicaria and P. punctatum), Bur oak (Quercus macrocarpa), Poison ivy (Rhus radicans), Sandbar willow (Salix interior), Ragwort (Senecio glabellus), Catbrier (Smilax hispida), Corralberry (Symphoricarpos orbiculatus), Slippery elm (Ulmus rubra) and Wild grape (Vitis riparia).

In the Freshwater Marsh there may be dense stands of grassy species with Prairie cordgrass (Spartina pectinata) the dominant. Other characteristic

components include Redtop (Agrostis alba), Big bluestem, Rice cutgrass (Leersia oryzoides and L. virginica), Michigan lily (Lilium michiganense), Bunchflower (Melanthium virginicum), Switchgrass, Cup plant (Silphium perfoliatum), Bulrush (Scirpus acutus and S. validus), Indiangrass, Eastern grama grass (Tripsacum dactyloides) and Cattail (Typha latifolia).

All of this site has been grazed. When the fort was active it would be surprising not to have had severely overgrazed and trampled areas close to stables and holding pens. Following abandonment it appears that most of the site was cultivated within a few feet of the river bank. Small, narrow fragments of the original prairie sod exist along the banks where trees and shrubs have not completely overgrown the site. Seeds from these few plants may eventually spread naturally into more of the planted areas.

The 44-acre detached area containing the Santa Fe Trail wagon ruts was originally Bluestem-Grama Prairie. Prairie dogs and Burrowing owls now occupying the site were common as the bison in areas where the grass was kept short. Grazing has eliminated for the most part the tall grasses from this area allowing Blue grama and Buffalo grass to dominate along with annuals such as Little barley (Hordeum pusillum) and Downy brome (Bromus tectorum).

Fluctuations in the weather and the occurrence of fire were very important factors in the original vegetation of this region. The dominants of the Bluestem-Grama Prairie oscillated eastward with periods of drought and westward with periods of higher precipitation. The Floodplain Forest and Savanna regularly would be damaged by lightning induced fires which limited the encroachment of the forest onto the upland prairie. Most of the elm trees along the river edge have been lost in recent years not to fire but to the Dutch elm disease.

### III. Management History

Most of Fort Larned except immediately next to the buildings was cultivated at one time prior to establishment as a National Historic Site. The 44-acre detached area has been grazed but never plowed. Detailed records are available on the replanting program which was begun in 1968 to convert the land back to vegetative conditions similar to the period of 1860-1878. Blue grama and Buffalo grass were planted in most cases in the fall in sudan stubble. Mowing at 4-6 week intervals was carried out on plantings as well as areas already in grass. Spring burning was done regularly on some areas after already established in grass. Herbicide spraying for dandelions and other broadleaved weeds was used on most areas in 1974 and 1975. A summary is shown in Table 1.

### II. Status of the prairie remnants and plantings

The grass management plots represent a successful program of reestablishing the native vegetation of the site. A brief paragraph on each plot would be useful in describing the species as observed in July 1975. Specific management suggestions will be included along with the descriptions and general recommendations will be covered in the next section of the report.

Plot 1 - One of the earliest plots (1969) established to Blue grama and Buffalo grass, plot 1 consists of an excellent stand of Blue grama, Buffalo grass, Silver bluestem (Andropogon saccharoides) and Big bluestem in the northern half and a scattered healthy stand of Blue grama and Buffalo grass in the south half. The roadside consists of a mixture of Bluestem-Prairie species which are slowly spreading into this plot. The abundance of fire weed (Kochia scoparius) and Annual brome grass (Bromus spp.) in the south half of the plot may be slowing down this spread. Some additional desirable species in this plot include Sand dropseed (Sporobolus cryptandrus), Canada wild rye, Ground plum (Physalis heterophylla), Silver bluestem, Western wheatgrass,

False boneset (Kuhnia eupatoroides), Switchgrass, Side-oats grama, and Little bluestem. Some additional undesirable species are Prickly lettuce (Lactuca scariola), Green foxtail (Setaria viridis), Dandelion (Taraxacum officinale), Alfalfa (Medicago sativa) and Goathead (Tribulus terrestris). Continue mowing the south half and discontinue mowing of north half or no more than once a year.

Plot 2 - Established in 1973, this plot is an excellent stand of Blue grama and Buffalo grass in early stages of spreading. Abundant Green foxtail as a weed along with Dandelion, Alfalfa, Bermuda grass (Cynodon dactylon), and Smooth brome (Bromus inermis) suggest that mowing should be continued. Irrigation overflow from the field to the south should be stopped or weedy infestation can be expected.

Plot 3 - An excellent, well stabilized stand of Buffalo grass and Blue grama with only problem being abundant Dandelion. Some other desirable prairie plants establishing including Silver bluestem, Virginia wild rye (Elymus virginicus), Canada wild rye (Elymus canadensis), Western ragweed, False boneset, Gaura (Gaura spp.), Switchgrass, and Tall dropseed. Mowing can be skipped for a year if Dandelions are sprayed; however, in the NE corner there is a patch of poor establishment which should be mowed.

Plot 4 - A weedy pasture with fragments of original prairie sod still intact. Mowing and spraying should be done only if weeds become intolerable. No seeding recommended until silos are filled in and then an overseeding only in those areas where the ground has been heavily disturbed. Try to protect the original prairie sod from further damage.

Plot 5 - Establishment of Buffalo grass and Blue grama is generally good to excellent with much weedy growth of Alfalfa, Green foxtail, and Prickly lettuce. Mowing should continue, but two inches higher, less often and a few feet farther from the river bank where some original prairie plants are still present.

Plot 6 - Established in 1973, this plot has a spotty, fair cover of Blue grama and Buffalo grass. Heavy cover of Prickly lettuce, dandelion, and lesser amounts of Horseweed (Conyza canadensis) and annual brome grasses should be controlled by mowing.

Plot 7 - An excellent stand of Buffalo grass and Blue grama has been established in this plot plus an impressive influx of other prairie species such as Switchgrass in abundance, Side-oats grama, Wine cup (Callirhoe involucrata), Big bluestem, Gaura, Sand dropseed, and Wild gourd (Cucurbita foetidissima). A strip along the east edge is heavily infested with Bermuda grass. Other weedy species include Bindweed (Convolvulus sp.), Dandelion, Curly dock (Rumex crispus), and Smooth brome. Mow early or not at all for a year to strengthen the tall species and spray the two small patches of Bindweed.

Plot 8. Attempts to establish short grasses in 1971 failed because of strong carry over of materials from former feedlot activities. Obtain a soil test and try to balance with addition of other nutrients. Seed to a mixture of tall grasses and spray for broadleaved weed control at least for first year.

Plot 9 - Excellent establishment of Buffalo grass and Blue grama has been achieved in the area marked 9B with fair to good establishment in 9A. Abundant Dandelion, Wild lettuce, Green foxtail and Annual brome grasses are present with Puncture vine in places where much driving has been done. Continue mowing and spraying for weeds.

Plot 10 - Excellent Buffalo grass and Blue grama turf is established with occasional Switchgrass, Silver bluestem, False boneset, Wild gourd, and Gaura. Goats beard (Tragopogon dubius), Dandelion and Wild lettuce are scattered abundant. Mowing can be raised higher and done less often.

Plot 11 - Established this year this plot shows good establishment of Buffalo grass and Blue grama on higher ground and poor in lower areas; however it depends on how the rains come. Alfalfa and Green foxtail are abundant. A good source of prairie plants occurs next to the river where mowing could be pulled back.

Plot 12 - Good establishment of Buffalo grass and Blue grama with weedy influence of Green foxtail and Wild lettuce. Mowing procedure appears adequate to maintain the short grasses.

Plot 13 - Establishment of Blue grama and Buffalo grass is good at the edges and spots but generally poor in areas of heavy Prickly lettuce. Several native prairie species are growing at the river bluff edge including Western wheatgrass, Side-oats grama, Big bluestem, Many flowered scurfpea, Narrow leaved milkweed (Asclepias stenophylla), Wine cup and Prickle poppy (Argemone polyanthemus).

Plot 14 - A few native species are present in this pasture area including Wild gourd, Western wheatgrass, Sand dropseed (Sporobolus cryptandrus) and Buffalo grass, but the main cover is Tall fescue (Festuca arundinacea) Orchard grass (Dactylis glomerata), Smooth brome, Annual brome grasses, Bermuda grass and Prickly lettuce. Several large cottonwood trees are present. Along the river edge the prairie plants appear. A small strip extends north along the road to the bridge which is well stabilized Bluestem-Prairie including species of Goldenrods (Solidago spp.), Blue lettuce (Lactuca pulchella), Poison ivy, Big bluestem, Canada wild rye, Many flowered

scurfpea, Wild licorice (Glycyrrhiza lepidota), Ironweed (Veronia fasciculata), Western ragweed, Sand dropseed, Side-oats grama, Western wheatgrass, Tall leadplant (Amorpha fruticosa), Skeleton weed (Lygodesmia juncea), Wild gourd, and many others.

The major portion of plot 14 will require mowing at times to control weedy growth however the strip along the river bluff requires nothing but an occasional spring burning.

Plot 15 - In weeds now from nearby cultivation, this plot should be planted to a native tall grass mixture and mowed high until weed control is achieved. A remnant edge of native plants which exists along the river bluff should be protected from damage during site preparation for planting.

Plot 16 - A remnant of original Bluestem Prairie with Buffalo grass and Silver bluestem most abundant. Mowing should be restricted to road ditch only to reduce Grass bur (Cenchnus spp.) occurring there. Occasional spring burning should be adequate maintenance procedure.

Plot 17 - An excellent stand of grasses has been obtained here with Buffalo grass, Blue grama, Silver bluestem, False boneset, Windmill grass (Chloris verticillata) and Canada wild rye. Mowing can be reduced or at least raised a few inches.

Plot 18 - A mixture of Buffalo grass, Blue grama, Sand dropseed, a few Silver bluestem, Wine cups and gourds are providing a good cover. Fireweed, Bermuda grass and Annual brome grasses are present as weeds. Mowing should continue as in Plot 19.

Plot 19 - A mixture of Bluegrass, Buffalo grass, Sand dropseed, Windmill grass, Wine cup, and a scattering of other plants such as Bermuda grass and Fireweed provide a fairly solid turf for the Headquarters grounds. Mowing should continue, without watering, to maintain this as a stand of native grasses, "beaten down" by heavy use.

Plot 20 - There are actually three segments to this plot, and each should receive separate treatment. The segment nearest the bridge is in poor shape from animal digging activity. It should be mowed occasionally until it can be reseeded to tall prairie species. The second segment to the north is in excellent native prairie with Big bluestem most abundant. Mowing is not recommended. The third segment near the state park should be mowed as it currently is being handled.

Plot 21 - Nothing should be done until silos are filled in. Mowing and spraying only if weeds become intolerable. Small patches of stabilized prairie sod present here should be protected from damage during the reestablishment process.

Plot 22 - A native strip of Western wheat grass, Silver bluestem, Gourd and many other species, this plot should be left unmowed and occasionally burned in the spring.

Santa Fe Trail Ruts - Moderate grazing has removed all of the tall grasses from this remnant of original Bluestem-Grama Prairie. The occurrence of abundant annual brome grasses and Little barley are also indicators of change from the original. It does not seem possible to maintain cover of mixed tall and short grasses that was typical of this area from 1860-1878 with the present grazing pressure. Therefore, grazing should be removed to regain the original representative species which may yet be present in a very depauperate condition in the sod.

#### I. Analysis of Management

In general, there has been a remarkable job of reestablishing the native grasses. Good common sense has provided a substantial basis for success in this rather experimental process. Records which have been kept on the areas are most useful and worth every extra hour of time they have taken. Although



specific suggestions have been made for each of the numbered plots, some general recommendations are in order.

1. Spring burning should be used less often than it has in the past, especially when combined with mowing. There is some damage to soil structure when exposed to intensive rain drop action. Puddling may occur on soils, especially silty clay loams, which would interfere with infiltration of water into deeper layers of the soil causing more run off and erosion and shortage of water in the deeper rooting zones of the soil. Thus, weaker plants can result in some cases from burning.

2. Mowing of vegetation around the buildings of Fort Larned is approximately at the proper height, however, mowing less often and at heights of six inches would be more desirable for out lying areas. This is especially true as tall grasses begin to return to the plantings either by nature or by design.

3. Away from the buildings the taller grasses and forbs should be encouraged to establish in the plantings. An overseeding of tall grasses should be done in those plots which have been recently established particularly 5, 9, 11, and 13. Establishment of plots 8 and 15 should emphasize tall grass species. With grazing there is a tendency for Buffalo grass and Blue grama to dominate on these soils; however, it is better from a stand point of management and from historical perspective to introduce more of the tall grasses and forbs to the plantings. More stability is achieved in the long run, and less maintenance can be expected eventually. The appearance, however, will be that of an uneven, mixed landscape, not a mowed pasture or neatly planted field.

4. Although grazing would be a difficult procedure to contemplate, it may be desirable to consider hay removal from some of the grass management plots in the future.

5. Many native prairie species are present in the area and through the course of time will spread naturally into the grass management plots. It would be desirable if a program of seed collecting could be established to encourage this.

6. In addition to the very excellent written records of accomplishment of grass establishment, it would be desirable to have photo stations to show visually the changes as they occur.

The following information is provided by the Soil Conservation Service District Conservationist at Larned, Kansas concerning planting specifications (3).

1. Seedbed. Normally forage sorghums or milo is seeded during the growing season prior to the winter or spring planting of the grass. Use row spacings not over 16 inches apart. Forage in excess of 12 inches stubble height may be removed.

2. Drilling. Native grasses should be seeded with a grass drill equipped with double coulter furrow openers with depth bands and press wheels or drag chains. Seeds should be planted 1/2 to 3/4 inches deep.

3. Seeding mixtures. Pawnee District, loamy upland sites. Add to the minimum for each species to total 4.5 pounds of PLS per acre. Total quantity of seed planted may be 10 percent more or less.

Min. and Max. for Each Species  
Pounds PLS/Acre

	Min.	Max.
Big bluestem	.8	1.6
Little bluestem	.4	.8
Indiangrass	.0	1.6
Side oats grama	.0	1.2

continued

	Min.	Max.
Switchgrass	.3	.6
Blue grama	.0	.4
Buffalo grass	.0	.6
Western wheatgrass	.0	1.2

Because most of the Fort Larned National Historic Site is already in permanent grass cover, the above mixture has limited application. It should be used in planting Plots 4, 8, 15, and 21. There is considerable flexibility in specific mixtures. For Plot 8, for example, I would use Big Bluestem (1.5), Little bluestem (.5), Indian grass (1.5), Switchgrass (.5), and Western wheatgrass (.5) to total the 4.5 pounds of PLS per acre. This is slightly different from the mixture I suggested earlier using more Switchgrass. For those plots where Buffalo grass and Blue grama are established and it is not necessary to mow as often and as low as has been done in the past, I would recommend an overseeding of Big bluestem, Little bluestem, Indian grass, Side oats grama, Switchgrass, and Western wheatgrass at 2 pounds or so PLS per acre. It is not surprising to see these species coming in on their own in Plots 1, 7, and 10, but it can be speeded up greatly by overseeding a mixture containing about equal amounts PLS. If seed of Canada wild rye, tall dropseed, sand dropseed and any of the prairie forbs can be obtained, it would be desirable to throw them in also. You have come a long way in the reestablishment process here with excellent records, but I think the additional input of tall prairie species will provide better weed control and less mowing than you have under the present set up. It will

be necessary to reeducate people to accept the taller, more uneven appearance of the mixtures that what they have been familiar with closely mowed.

An interpretive program using the native species should be established even though this is not the primary objective of Fort Larned. It will help in the long run to interpret the many aspects of the environment that influenced life during the 1860's and 70's to provide visitors with a deeper appreciation of our pioneer heritage.

## II. Local References

- (1) National Park Service. 1968. Fort Larned National Historic Site.  
Kansas. Brochure.
- (2) Kuchler, A. W. 1974. A New Vegetation Map of Kansas. Ecology 55 (3):  
586-604.
- (3) Soil Conservation Service. 1974. Kansas Standards and Specifications  
for Range Seeding. Section IV TG Notice KA-3, 4/16/74.

Table I  
Grass Management Plots

Last Crop	Year Established To Blue grama & Buffalo	Sprayed 2,4-D	Mowing	Spring Burning	Condition	Recommended over seeding
Kilo	69	75	69-75	71-74	Good	e
Sudan	73	75	73-75	75	Excellent	yes
Sudan	69	74 75	69-75	71-75	Excellent	e
Grass	b		d 73 74	73 74	Mixed	e
Sudan	74	75	74 75	75	Good	yes
Sudan	73	75	73-75	74	Fair	yes
Sudan	71	74 75	71-75	73 74	Excellent	e
Weeds	71a	75		74	Fallow	
Sudan	73	74 75	73-75	74	Fair to Excellent	yes
Sudan	71	74-75	71-75	73 74	Excellent	e
Alfalfa			75		Poor to Good	yes
Alfalfa			75		Good	yes
Sudan	74	74 75	74-75		Poor to Good	yes
Pasture	b		68-75	73 74	Fair	
Weeds					Fallow	
Grass	b	75	68-75	68-74	Good	e
Grass	c	75	68-75	68-74	Excellent	
Grass	c	75	68-75	73 74	Fair	
Grass	c	74 75	68-75		Good	
Grass	b	75	68-75	73-74	Poor to Excellent	e
Weeds				68-72	Mixed	e
Grass	b	75	71-75	73-74	Fair	e
Grass	b		Grazed		Fair	e

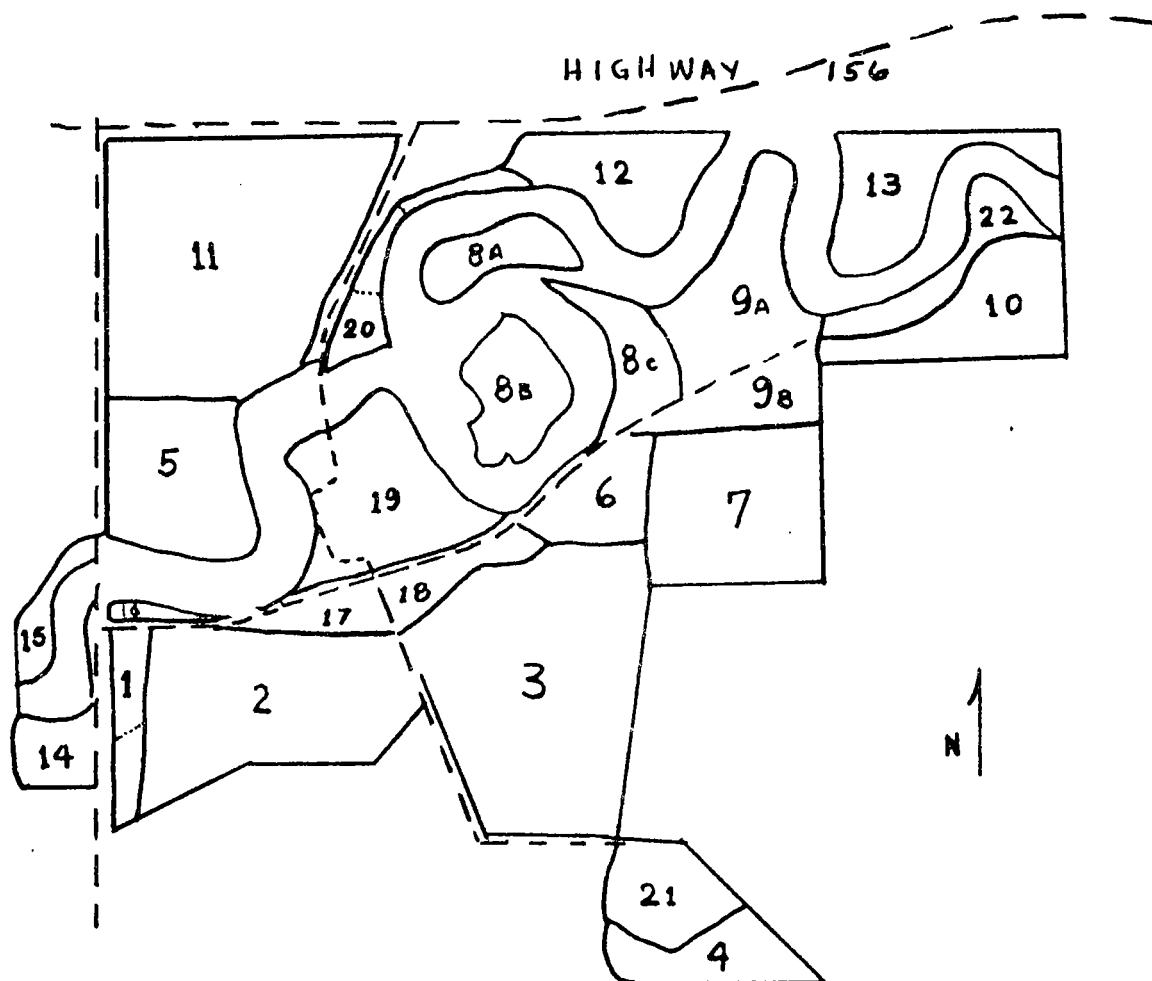
Share to establish

Partially in native prairie species

with many native prairie species

Shared two horses 69-72

Native prairie grasses adequately established



FORT LARNED NATIONAL HISTORIC SITE

FIG. 1

## Wilson's Creek National Battlefield

### I. Historical Setting

"The Battle of Wilson's Creek was fought . . . . on August 10, 1861 between Union and Confederate forces for control of Missouri in the first year of the Civil War" (1). The highest point in the park, named Bloody Hill because the fiercest action of the battle took place there, provides a view of the whole Battlefield. It takes on the atmosphere of a frontier crossroads where two Armies met in a brief but deadly encounter. The National Battlefield comprises 1730 acres.

### II. Natural History

The area is probably less forested today than it was in 1861 and certainly more forested than it appears in the 1936 aerial photographs. The forests are probably of a different structure today than originally even though they may be composed of the same species. Some accounts of the battle describe the men marching through park-like forest. This would be typical of mature Oak-Hickory Forest, uncommon anywhere in the vicinity today. It is approaching maturity in one area of the park in the SE corner, east of the abandoned railroad right-of-way. The Bloody Hill forest was selectively cut for timber in the 1930's; therefore, much of it is regrowth of small trees and shrubs and anything but park-like or mature. A few very old trees still remain which could have been sizeable trees during the battle and too hollow or crooked for cutting during subsequent timber harvests. It was also noted at the time of the battle the river bottom was an impenetrable jungle, a condition which is much the same today.

The original vegetation was a mosaic of Oak-Hickory Forest, Bluestem-Prairie, and brushy or scattered tree "edge" (2). The limestone ridge comprising Bloody Hill supports a shallow rocky soil which would be very unlikely

cleared for agriculture but which would support an adequate forest with Hickories (Carya spp.), Chinkapin oak (Quercus muhlenbergii), Red oak (Q. rubra), Black oak (Q. velutina), Post oak (Q. stellata), Black jack oak (Q. marilandica), Ash (Fraxinus americana), Basswood (Tilia americana), Black walnut (Juglans nigra) and Elm (Ulmus spp.). A large open-grown Red oak tree in hay field NW of the Ray House had fallen within the past year. Its growth rings rather clearly showed an age of approximately 110 years, which would have placed it as having started in the decade after the Battle. The only other trees which appeared to be older were those few on Bloody Hill in the midst of young trees, shrubs, and scattered plants of the prairie in open spots. These included Side oats grama (Boutelous curtipendula), Little bluestem (Andropogon scoparius), Switchgrass (Panicum virgatum), Prickly pear (Opuntia sp.), Ruellia (Ruellia strepens), and many others.

The Bluestem-Prairie of this region would be dominated by Big bluestem (Andropogon gerardi), Little bluestem, Switchgrass, and Indian grass (Sorghastrum nutans) with other components including Side oats grama, Black eyed Susan (Rudbeckia hirta), Butterfly milkweed (Asclepias tuberosa), Purple coneflower (Echinacea pallida), Prairie clover (Petalostemon spp.), Aster (Aster spp.), Daisy fleabane (Erigeron strigosus), Blazing star (Liatris asper), Wild bergamot (Monarda fistulosa), and many others. But there is a strong tendency for shrubs and trees to establish in the prairie, and to replace it unless controlled by recurring fires. To start with these include Blackberries and Black raspberries (Rubus spp.), Multiflora rose (Rosa multiflora), Cedar (Juniperus virginiana), Buck brush (Symphoricarpos orbiculatus), Dogwood (Cornus spp.), Wild grape (Vitis spp.), Sumac (Rhus glabra), Sassafras (Sassafras albidum), Persimmon (Diospyros virginiana), and Black cherry (Prunus serotina).



### III. Management History of the Prairie Areas

It is a difficult task to assemble specific information on the management of various units because of scattered records and the shortage of time to search them out. Some areas are being leased for grazing, others are mowed and others, although once open fields, are essentially being left alone to the advance of woody plants. Planting of some of the old fields to native prairie species began in 1967 south of Bloody Hill. Accordingly the area south of the entrance road to Bloody Hill was plowed and planted in 1968 whereas the fields NE of the Ray House were not plowed before overseeding with prairie seed. Additional areas in the NE section and in the extreme SE section were plowed and planted to prairie species. These mixtures included Big bluestem, Little bluestem, Switchgrass, and Indian grass each time.

None of the prairie forbs were included because of a lack of seed. Some portions have been planted to Kentucky 31 fescue (Festuca arundinacea) and other pasture grasses, presumably before the recent trend to native prairie species.

The status of the prairie in most areas is excellent; however in all cases except south of the Bloody Hill trail there is vigorous invasion by woody plants. The area south of Bloody Hill is the best example of prairie establishment and maintenance. The planting at the entrance to Bloody Hill is well covered with prairie species but has abundant growth of woody plants too large to be handled by an ordinary mower now. The broadcast planting across from the Ray House is in fair cover of prairie species. There the established grasses of the old field succession provided more competition than would have occurred if the field had been plowed first. Erosion was controlled by this procedure, and the prairie grasses will eventually establish a more desirable cover, that is, if woody plants can be discouraged from coming in. The 1971 plantings are in excellent condition.

In both instances the woody plants are beginning to come in. The planting in the SE corner differs from the other areas in that here the woody invaders are sycamore (Platanus occidentalis) instead of the mixture described earlier. Ray's cornfield is now an open field covered with pasture grasses and heavy fence rows of shrubby trees along the edges.

Fragments of prairie exist along the county road right-of-way at the NE corner of the park and in the vicinity of the General Lyon Marker on Bloody Hill. The few species remaining include a few of the grasses but mostly the showy flowers of the prairie.

#### V. Analysis of Management

It is a difficult task to recommend specific procedures here because of the complex mosaic forest, prairie and field and the lack of definition of what type of vegetation should cover the Battlefield. Should it be as it was on August 10, 1861? If so, what is the best description of that vegetation? Then how can management achieve that vegetational goal? It seems I am working on the third question before having the first two answered.

The emphasis should be on maintaining the Battlefield as naturally as possible as long as it moves toward that desired vegetational goal of 1861 conditions. Grazing and haying should be compatible then if they keep areas open that should be open. Another alternative is the use of prescribed burning. Fires set by lightning and human activity have long had an impact on the Bluestem-Prairie and Oak-Hickory Forest of this region and could be used under carefully arranged conditions to maintain prairie openings at the forest edge.

I may be overstepping my assignment in making these recommendations; however, it is impractical to advise on use of prairie species in management without knowing clearly what is desired in relation to other vegetation types.

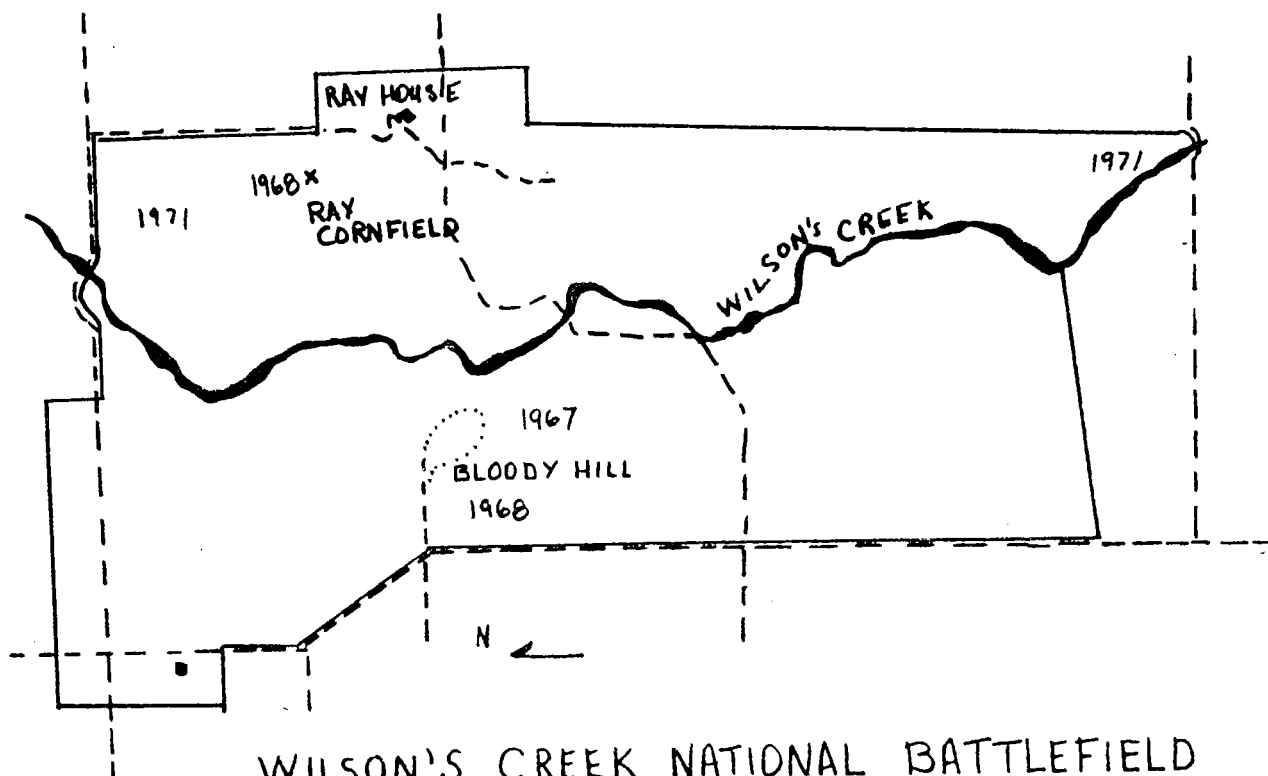
1. Determine through historical research and ecological extrapolation what the limits of forested, pasture and cultivated land were at the time of the battle. Perhaps this is known well enough today to sketch it out on a master plan of the park so that all maintenance could be oriented toward achieving that goal. Then certainly by the Bicentennial of the Battle a reenactment could deal with a rather realistic vegetation, probably even by the 150th Anniversary. I am assuming that "pasture" in 1861 would be primarily native prairie species.
2. Where established pasture is desired this must be achieved with a program of controlling woody plant invasion. Already some portions near the entrance to Bloody Hill have small trees and shrubs which must be removed by hand or special brush-cutter machinery. Because many of the pasture species, in contrast with native 'prairie species, are damaged by burning, I would endorse a procedure of mowing at least once a year to control the woody sprouts but not too often to weaken the pasture species. Mowing at 6 to 8 inches instead of the present low level will control woody growth without damaging the herbaceous plants.
3. Retain the Ray cornfield in pasture grasses at the present time. Perhaps in the future a procedure can be worked out to grow corn on the area using 1861 techniques and getting 20-40 bushels per acre. Chances are, erosion would prevent the continuous use of the slope for corn. Some manner of cultivation on advice from the local Soil Conservation District to reduce erosion to a minimum should be used if it is ever planted to corn.
4. Utilize prescribed burning on a trial basis for some of the area that will be retained as open pasture or prairie. Personnel from the Missouri Department of Conservation who are familiar with the use of fire in prairie management would be ideal and willing consultants in such an endeavor.

Areas in nearby counties are under the management of the Department of Conservation for improvement of prairie chicken habitat (4). A similar program could be developed for Wilson's Creek Battlefield because of the growing interest in interpretive aspects of the natural surroundings in conjunction with the primary objective of the park.

5. Establish a collection of plants of the area similar to the herbarium collection at Carver. A problem which arose during my visit emphasized the need for such a reference collection. Although complaints had been made in the past from neighbors on the presence of Russian thistles in the park, we were unable to find any plants similar to what has been called Russian thistle elsewhere. We found the rather visible but short-lived tall thistle (Cirsium altissimum), but no Canadian thistle or Russian. Nor was I able to find out through calls to the County Agricultural Agent or personnel at Carver what exactly the plant was we were seeking. The area is rich in wildlife of all forms, and more care should be taking in promoting this healing aspect to the scars of the Battlefield.

## II. Local References

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WILSON'S CREEK NATIONAL BATTLEFIELD

FIG. 1

## George Washington Carver National Monument

### I. Historical Setting

The Monument to George Washington Carver was established in 1952, nine years after his death January 5, 1943. He had grown up on the land probably exploring every square foot, all 210 acres of it, before he sought further schooling elsewhere in his mid teens (1).

### II. Natural History of Area

The agrarian nature of the landscape that exists today is probably changed only by degree from what it was in 1870 during the boyhood days of George Washington Carver. Fields, pastures, gardens, orchards, and forested land have persisted to this day. The original vegetation can only be guessed at; however, it was probably a mixture of Bluestem-Prairie and Oak-Hickory Forest which was to be settled and farmed before 1850. Dominants of the Bluestem-Prairie were Big bluestem (Andropogon gerardi), Little bluestem (Andropogon scoparius), Switchgrass (Panicum virgatum), and Indian grass (Sorghastrum nutans) with other components including Lead plant (Amorpha canescens), Aster (Aster spp.), Side-oats grama (Bouteloua curtipendula), Sunflowers (Helianthus spp.), Blazing stars (Liatris spp.), Silverleaf scurfpea (Psoralea argophylla), Coneflower (Ratibida pinnata), Prairie rose (Rosa arkansana), Compass plant (Silphium laciniatum), Goldenrods (Solidago spp.), and Purple coneflower (Echinacea pallida) (2).

Prairie areas were used for haying or grazing if they were not plowed. The 19-acre pasture west of the visitor center is dominated by native prairie species. One photograph of the Shartel buildings taken from the zinc mine to the SW shows the Carver family cemetery and open pastured land. Two close-up photographs in 1952 show grass cover about six inches high in the winter, but no identifying characteristics of the grasses are visible. The 1953 aerial photograph clearly shows the conditions of the farm and the more or less open character of the wooded area along Carver Branch. Trails to the cemetery and the zinc mine are readily visible passing through the

19-acre pasture.

### III. Management History of Areas

It is not known whether the 19-acre pasture was ever plowed. It is known that since 1952, when it was mostly ragweed, it has been mowed twice a year until 1974 when mowing was changed to once a year, late in the year. No planting of native species has been done to the knowledge of present maintenance staff. On the sketch prepared at the turn of the century it is listed as pasture.

Hay and silage ground is being leased out for management in accordance with Soil Conservation Service recommendations.

The area to the west has been heavily grazed for some time in the past.

The garden area behind the visitor center is very appropriate. Surrounding the cultivated ground is found a mixture of pasture species including Orchard grass (Dactylis glomerata), and Kentucky bluegrass (Poa pratensis).

### IV. Status of Prairie Areas

The 19-acre area from the kitchen garden to the south is an excellent example of original prairie. In July it was a solid view of Black eyed Susan (Rudbeckia hirta) and grasses. Many species are represented, with Beaked panic (Panicum anceps), Little bluestem, Big bluestem, Indian grass, Switchgrass, Daisy fleabane (Erigeron strigosus), Cinquefoil (Potentilla recta), and Purple coneflower as abundant members, and other representatives including Paspalum (Paspalum spp.), Fescue (Festuca arundinaceae), Japanese brome (Bromus japonicus), Rough blazing star (Liatris asper), Blazing star (L. pycnostachya), White aster (Aster pilosus), Wild lettuce (Lactuca spp.), Hawkweed (Hieraceum spp.), Ruellia (Ruellia strepens), Stinging nettle (Urtica urticifolia), Sweet william (Verbena canadensis), Nutgrass (Cyperus spp.), Sensitive plant (Schrankia incinata), Tick trefoil (Desmodium spp.), and Eastern spina grass (Tripsacum dactyloides).

No woody plants are invading, but on the highest point a few stems of Honey

locust (Gleditsia triacanthos) and Smooth sumac (Rhus glabra) are an indication of what might move in if mowing is stopped.

Along the forest edge and stream are many herbaceous plants that function best in slightly shady or moist conditions. Because of storm damage in the past two years, many of the understory plants which respond to disturbance are rather vigorous. These would not be prairie plants necessarily, but they would have been common in earlier times also along trails in the woods and along the edge. They include Purple top (Tridens flavus), Rosin weed (Silphium integrifolium), Panic grass (Panicum clandestinum and P. latifolium) Beaked panic (Panicum anceps), Poison ivy (Rhus radicans), Small Black eyed susan (Rudbeckia triloba), Boneset (Eupatorium spp.), Cup plant (Silphium perfoliatum), Avens (Geum canadense), and Wild rye (Elymus villosus and E. virginianum).

#### V. Analysis of Management

George Washington Carver National Monument is a pleasant place to visit, not only from the standpoint of a healthy reconstructed prairie, but also because of the pleasing quietness interrupted only by the distant hum of human activities and the constant chortle of mockingbirds, bob white quail, and other birds or their imitators. There is a pleasing aspect of the entire area, its balance of buildings, grounds, garden, woods, and prairie that somehow are in keeping with the personality of George Washington Carver. My recommendations are, generally, to continue exactly what has been done in the past, with a few minor exceptions. Hay fields to the south are compatible with the park only if they are kept in good shape, that is, the one behind the guest apartment is predominantly annual weeds. Mowing could be done there more easily if the mower were set higher or the rocks removed. If the whole area is to be retained in the 1870 setting, then there should probably be other crops growing somewhere rather than so much hay ground. The prairie would be the best example of hay or pasture ground then.



The problem of weedy species in the wooded areas is outside the scope of this study; however, it is related to the whole maintenance picture and should be briefly mentioned. Any kind of disturbance in the woods or prairie whether the removal of storm damaged trees or mowing undergrowth has a tendency to allow aggressive plants, such as poison ivy to expand. Some control of poison ivy has been obtained elsewhere by careful hand pulling by well-protected, less-sensitive people and by the use of burning. I would not recommend burning here nor do I see it as a necessary part of the prairie under the present management.

I was impressed with the herbarium. It is an excellent resource which can play an important role in the nature interpretive program which is bound to be a higher priority program in the next few years. The markers along the trail are informative and important, but there is a more apparent need for a brochure which helps the visitor see more of the natural scene to which the young George Washington Carver was closely tuned. The present trail guide is inadequate because it provides very little information about nature as he knew it and it talks down to people.

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- (1). National Park Service. 1973. George Washington Carver National Monument. Missouri. Brochure.
- (2). Küchler, A. W. 1964. Potential Natural Vegetation of the conterminous United States. American Geographical Society Special Publication No. 36. Manual to accompany the map.
- (3). Maze, Terry E. 1973. A walk along the Boy Carver Nature Trail. George Washington Carver Birthplace District Association. Brochure.

## Ozarks National Scenic Riverways

A very brief visit to the area around Van Buren was adequate to see the extent of the management problems associated with the Ozarks National Scenic Riverways (1). Conversations with Earl Kinder and Leo Marnell reinforced my observations. The availability of the condensed report of Paul Redfearn was useful in providing background information. Because of the far flung characteristics of this riverway and predominance of natural forest vegetation throughout the region, it is my conclusion that vegetation management should consist largely of a hands-off policy for the forested land, a contract arrangement with local residents on haying bottomlands, and intensive maintenance only of key stop-over spots near the river. The practice of haying formerly cultivated land will eventually need close examination because under the usual tenant operation, as woody plants encroach, less effort is expended to control them until more and more of the field grows up to Honey locust (Gleditsia tricanthos), Elm (Ulmus spp.), and other weedy trees and woody vines. The use of prairie species in the bottomlands for haying is not appropriate. A study involving the management of these bottomlands would need to examine economical impact locally as these lands are further removed from agricultural production.

The appearance of prairie species along ridges and open glades is apparently a natural response to the severity of the site. I agree with Redfearn that the barrens are successional stages in this forest climate; however, for management considerations they will be around a very long time on the more severe slopes. Naturally occurring fires and prescribed burning would tend to expand the prairie influence, whereas complete fire protection would speed up the successional process.

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(2) Redfearn, Paul L., Jr. ca 1968. Basic Natural resource Data for the Ozarks National Scenic Riverways. Botany section pp. 183-203. National Park Service.

## Indiana Dunes National Lakeshore

### I. History

Proposals as early as 1917 to preserve the once vast dunes system on the southern shores of Lake Michigan were largely unsuccessful in competition with the rapidly expanding development of the area for industrial and residential uses. An Indiana Dunes State Park was established in 1923, but it was not until September 8, 1972 that the National Lakeshore was officially established comprising approximately 5000 acres (1). "The purpose of the national lakeshore is to protect the remaining shoreline, dunes, marshes, and the ecology of plants and animals in an environment produced by the actions of glaciers, lakes, and wind."

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### II. Natural History of the Area

The natural history of the dunes is a complex geological and biological maze that has fascinated ecologists since the beginning of this science just before the turn of the century. In fact, the dunes area has been described as the birthplace of plant ecology in North America as it first attracted the talents of H. C. Cowles, University of Chicago, to unravel its mysteries (2). The physiography of the dunes creates a mantle of vegetation complex in structure, species composition, placement and timing; from bare, shifting sand to prairie, marsh, bog, and forest.

It is not the intent of this report to go into detail on vegetation types other than Bluestem-Prairie, and even this is almost overwhelming because of the chopped-up characteristics of the National Park holdings and the subtle changes in species composition from one area to another. The four major categories of prairie are selected for convenience not that they are distinct entities but that they represent diverse points on a continuous scale of

change from marsh to open dune sand. They are Prairie Marsh, Low Prairie, Mesic Prairie, and High, Dry Prairie (3).

The Prairie Marsh is found where water stands for a major part of the year. Some indicator species are Swamp milkweed (Asclepias incarnata), Blue joint grass (Calamagrostis canadensis), and Marsh boneset (Eupatorium perfoliatum). Other species would include Sweetflag (Acornus calamus), Flat-top aster (Aster umbellatus), Water hemlock Cicuta maculata), Blue flag (Iris virginica), Great blue lobelia (Lobelia siphilitica), Bugleweeds (Lycopus spp.), Sensitive fern (Onoclea sensibilis), Meadow rue (Thalictrum dasycarpum), Sloughgrass (Spartina pectinata), and many others including those of the Low Prairie.

The Low Prairie occupies poorly drained low swales and valleys which tend to be excessively wet in spring yet which by autumn are dry. Species indicative of low prairies include Sloughgrass (Spartina pectinata), Marsh blazing star (Liatris spicata), and Glaucous white lettuce (Prenanthes racemosa) with Big bluestem (Andropogon gerardi), Wild onion (Allium canadense), White fringed orchid (Habenaria leucophaea), Turk's cap lily (Lilium michiganense), Loosestrife (Lysimachia spp.), Winged loosestrife (Lythrum alatum), Marsh phlox (Phlox glaberrima), Wedge scale grass (Sphenopholis obtusata), Ironweed (Vernonia fasciculata), Golden alexanders (Zizia aurea) and many others including some of the Mesic Prairie.

The Mesic Prairie contains the largest number of species of any of the four because of its position on moist land which is usually level, gently undulating and well drained. Some indicator species are Prairie dock (Silphium terebinthinaceum), Compass plant (Silphium laciniatum), Big bluestem, Purple prairie clover (Petalostemon purpureum), and Purple coneflower (Echinacea pallida). Other species include Lead plant (Amorpha canescens), Butterfly milkweed (Asclepias tuberosa), Smooth blue aster (Aster laevis), False indigo (Baptisia leucantha and B. leucophaea),

Rattlesnake master (Eryngium yuccifolium), Bigtooth sunflower (Helianthus grosseserratus), Bush clover (Lespedeza capitata), Blazing stars (Liatris aptera and L. pycnostachya), Wild bergamot (Monarda fistulosa), Switch grass (Panicum virgatum), White prairie clover (Petalostemon candidum), Prairie phlox (Phlox pilosa), Prairie coneflower (Ratibida pinnata), Goldenrods (Solidago missouriensis and S. rigida), Indian grass (Sorghastrum nutans), Porcupine grass (Stipa spartea), Prairie dropseed (Sporobolus heterolepis) and many others.

The High, Dry Prairies occur more often on high well-drained rocky hills but some of the same species are able to dominate the sands following initial stabilization. Indicator species include Little bluestem (Andropogon scoparius), Side-oats grama (Bouteloua curtipendula), and Silky aster (Aster sericeus). Other species are Pasque flower (Anemone patens), Downy yellow painted cup (Castilleja sessiliflora), Tick trefoil (Desmodium illinoense), Prairie smoke (Geum triflorum), June grass (Koeleria cristata), False boneset (Kuhnia eupatorioides), Blazing star (Liatris cylindrica), Yellow flax (Linum sulcatum), and Porcupine grass (Stipa spartea).

One of the unusual aspects of the dunes is that typical classifications are hard to apply. Portions of Dune Acres, for example, would fit into Prairie Marsh, Low Prairie and Mesic Prairie within the space of a few yards. Then there are the savanna areas with perfectly good Mesic Prairie beneath a very open Black oak (Quercus velutina) canopy as found in West Dunes along the south side. Because of the great physiographic diversity there is also great biotic diversity and the juxtaposition of very different plant communities, which gives the appearance of rapid successional change. Change here is certainly more rapid relative to active dune formation; however, for the most part the rate of change is similar to other systems, and is largely due to the impact of human involvement.

### III. History of Management of Prairie

Management has been slight in the areas of the Lakeshore designated as prairie. Some protection from vehicles and trail formation has been provided. Fire has not been used; however, inadvertently it has played a major role in the retention of prairie in a climatic region supporting forest growth. Accidental fires have occurred frequently in rich prairie areas such as Hoosier Prairie and within the lakeshore at West Dunes in proximity to a fire-generating railroad right of way. Mowing, spraying or replanting of prairie areas has not been done.

### IV. Status of Prairie Areas

Had I known what was originally along the shoreline of Lake Michigan compared with what is present today, I may have been too depressed to continue this report. Instead, I am impressed with the large amount of prairie vegetation, in fact, of all the categories of natural vegetation that are found within the Lakeshore. Although considerably fragmented and influenced by drainage, air pollution, human traffic, and other disturbances there is a promising nucleus of natural vegetation to work with. I will cover the following areas: Prairie openings in Dune Acres, South side savanna at West Dunes, Savanna ridges to the north at West Dunes, Hoosier Prairie, Old field succession at Bailly, and sand pit Succession at West Dunes.

1. Prairie Openings in Dune Acres (I am unsure of this location on Reshkin and Krekeler's grid system (4). Small openings in the forest canopy, some less than ten meters across, are dominated by mesic prairie species and some forest understory species with clusters of trees dominating on slightly higher ground. Little influence of fire is evident, and the vegetation appears to be changing very slowly toward shrub and tree dominance. The

diversity of prairie species is high in each opening. An extensive interpretive trail system could be established here with relatively less trail erosion than in areas with steeper topography. Earlier I suggested that trails might be changed as wear began to show; however, on further examination the better suggestion would be to establish trails permanently and stay with them with additions of wood chips or other approved substances. The moving of a trail system as wear begins to show would increase the chances of destroying some of the rare plants in the area. Two orchids observed in Dune Acres were Habenaria lacera and Spiranthes cernua neither of which is rare in the dunes but they often go unnoticed. Because of the proximity to residences and its relative stability, the use of controlled burning is not recommended. Maintenance would largely consist of protection from vehicle traffic and excessive trail formation by hikers. Fire would not be catastrophic as far as the prairie is concerned, but it would damage trees and shrubs which form the edge of the openings. With a burning program over a period of several decades Dune Acres would probably take on the appearance of the south side savanna of West Dunes described below.

2. South side savanna of West Dunes (Reshkin and Krekeler - West Beach I - From right J slanting to left 0 and numbers 8 to 16). Black oak trees are rather consistently spaced on the low ridges with a few other hardwood species. Beneath the rather open oak canopy and dominating the lower ground between the ridges and the marsh to the north is mesic prairie. Fire scars on the bases of trees and the absence of intermediate size trees indicate that fire influence has been strong in recent years, probably related to the proximity of the railroad. A wealth of prairie and forest understory species occur together with retarded shrubs and small tree sprouts. Often regarded as savanna, this vegetative community may contain similar species lists as the prairie openings mentioned above but the structure is very different.

Instead of forest with prairie openings, here the two communities become intermixed due to the resistance of the thick-barked large trees and the susceptibility of small trees and shrubs to damage by fire, and the ability of prairie species to respond. Because it has burned accidentally on numerous occasions, it has developed a rather stabilized vegetation adapted to this environmental stress. Fire should be used perhaps once in four or five years unless it happens often enough on its own. Optimum time of burning is not known for this vegetation, but it would probably be during early spring with moist soil and drying winds.

Paths along the open, low ridges would provide an excellent route for interpretive nature trails showing the impact of fire. Prairie and forest species in abundance, numerous fire scars on the trees and stumps, the marshes and dunes to the north, all give a wealth of material to relate to the visitor. Management should maintain the open view through the understory rather than allow it to fill back in as it will do naturally and rapidly. Damage by vehicle traffic is evident, but routes could be selected where foot trails would create little erosional impact.

3. Savanna to the north, West Dunes (Reshkin and Krekeler - West Beach I - J, K, L; 1, 2, 3). This is a very similar situation to the savanna area to the south; however, here the topography is more extreme and the tree composition more varied. The steeper topography supports a drier prairie, but not quite in the category of High, Dry Prairie described earlier. Without fire there will be a gradual filling in of woody plants, especially on the moister, north-facing slopes. The use of prescribed burning would be questionable here because of potential control problems. Trail erosion is a problem, partly due to the steeper topography but also because of the



impressive view of the interdunal pond to the south which probably attracts a larger number of people on nature study hikes into this area compared to the south side savana. A rather complete study should be made here before anything further is done with the prairie.

4. Hoosier Prairie. Although not part of the park system at the time of this report, the Hoosier Prairie area deserves mention as a potentially very important addition. This large area of rather poor drainage is a rich mosaic Mesic Prairie and Savanna, Low Prairie and Prairie Marsh. The evidence of fire influence is readily apparent in the arrangement of scattered clusters of Black oak and other tree species with prairie species in the understory. Part of the area north of the pavement was burned accidentally in April, 1975. An increase in flowering of the prairie grasses and forbs was visible, and damage to the shrubs and small tree sprouts was apparent without much if any damage to the large overstory trees. Most impressive was the array of rare plant species remaining in the area such as the Yellow twayblade orchid (Liparis loeselii), Snakemouth orchid (Pogonia ophioglossoides), and Grass Pink orchid (Calopogon tuberosus) (5). Many others would be expected if observations were continued through the entire growing season.

Burning would be recommended in the management of this area, perhaps once every four or five years with not more than 1/2 being fired in any one year. The area is valuable first as a scientific preserve and seed source of many of the native wet prairie species and second as an interpretation site for the advanced student of the prairie. Its management should consist mainly of protection from changes in drainage and destructive incursions from the public. Dumping of garbage would increase if it were not for the narrow road and lack of parking which makes it rather dangerous to stop.

5. Old field succession - Bailly (Reshkin and Krekeler - Bailey Homestead III - H, I, J, K; 8, 9 - Unsure of this location). These large open areas are undergoing a rather slow secondary succession, at this stage rather generally dominated by Goldenrod, Wire rush (Juncus spp.), Sedges (Carex spp.), Canada bluegrass (Poa compressa), with patches of other species such as Prairie dock and Hawkweed (Hieraceum spp.). Few woody species are present, Prairie crabapple (Pyrus iowensis), and Hawthorn (Crataegus spp.) at the edges, with a few other species scattered in the area. It is expected that woody plants will begin to dominate the area in the next decade, eventually returning the area to forest. No herbaceous weed problems were observed.

A few prairie species have moved back into the old field from remnants along the adjacent railroad right of way. Natural movement of prairie seeds into the site would be a slow process, and the chances are slim of its remaining open long enough for many prairie species to establish before shaded out by woody plants. Burning or mowing would prevent this from occurring if an open prairie area were desired. It is an excellent site to observe the recovery process on formerly plowed land with photo stations set up to record the change and with portions planted to various mixtures of stabilizing species of native plants, both prairie and forest species.

Burning would be difficult to sustain in the site because of a shortage of grass as fuel. Mowing would suffice for controlling woody plants until sufficient fuel accumulates; however, it would be desirable to get more of the native grasses established soon. Some establishment would occur if seeds were scattered over the area by hand, with a fertilizer spreader, or a seed drill. I would encourage seed collection locally by volunteer sponsorship. Species such as Prairie dock, Prairie clover, Goat's rue, Tick trefoil, Rattlesnake master, Blazing star, Black eyed Susan, Compass plant, and others should be collected until several weeks after frost in the fall. Grasses

such as Little bluestem, Switchgrass, Big bluestem, Indian grass, and Sand reed must be collected earlier as seeds begin to shatter soon after early fall maturity. I would emphasize collecting your own seeds rather than purchasing them because the plants occupying the Dunes are genetically a bit different from those in the rest of the Midwest Prairie. Any of the species listed in the descriptions in section II of this report would be suitable for use in future plantings but not necessarily in this site.

6. Sand pit succession, West Dunes (Reshkin and Krekeler - West Beach I - From right D, E, F, G, slanting to left G, H, I, J, K, L; 8 to 12). This area represents a rather stabilized stage of sand dune succession in the early stages with Sand reed the most abundant grass. Switchgrass, Little bluestem, Rough blazing star, Prairie rose, Junegrass, Prickly pear, Dotted mint, Spiderwort, Canada wild rye, and others provide a rather sparse vegetative cover. Even at that it is competitive enough to restrict most other species including woody plants except for scattered Cottonwood trees in moist sites and scattered Chokecherry, Sand cherry, Sumac, and Bearberry. No manipulation is needed to retain its present characteristics for many years. It provides a rather large area of similar habitat that will gradually increase in numbers of native species over decades, but which is probably limited at the present time by shortage of nutrients and water in the loose sand substrate. Because of the rather flat topography no erosion of any consequence was evident.

In a note from Dr. David Niemann (5) he mentioned another area one mile north of Hoosier Prairie in Section 3, just north of the New York Central and Indiana Harbor Belt railroad tracks that was once rich with the Large yellow lady's slipper in abundance and Showy lady's slipper in small numbers. He recalled meeting a retired engineer from a steel company who had known the area for many years. Part of it used to be an arbor vitae swamp. He is Mr.

Norman Bergendahl, Mdt. Rt. Box 480, Chesterton, Indiana. He has copies of a topographic map of the area showing the dunes and swales he drew himself. The importance of such areas, even if a fragment of their former size, cannot be overemphasized as sources of seeds and other materials. They may not be large enough to survive long on their own, but they might provide the seed source left for reestablishment in a more protected area of the park system.

#### V. Analysis of Management

Little can be added here because of the relatively recent recognition of the importance of the prairie openings in the park and the lack of management objectives. Inadvertently, fires have been occurring frequently enough to maintain vigorous prairie areas. Tentative recommendations are discussed in the previous section of this report; however, there is one general recommendation that I would propose regarding the Indiana Dunes National Lakeshore. That is, to conduct additional analysis of prairie vegetation, requiring a minimum time of field study of one growing season, preferably longer, to provide the details needed for both management and interpretation of this unique resource. Because of its importance as the birthplace of plant ecology in this country, if for nothing else, the Dunes is worthy of vigorous and enlightened management. Prairie vegetation is only a part of its significant features, and the proper integration of management procedures is essential to retain as much of the original landscape as possible with prairie vegetation a balanced part of the whole system.

#### VI. Local References

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- (2). Cowles, H. C. 1899. The ecological relations of the vegetation of the sand dunes of Lake Michigan. Botanical Gazette 27:95-117, 167-202, 281-308, 361-391.

- (3). Betz, Robert F. 1965. Prairie Plants of the Chicago Region. Morton Arboretum. Booklet 3.
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## Annotated Prairie Bibliography

A group of references are singled out as significant contributions of the past decade that encompass much of the present mood of prairie research, interpretation, and understanding. They have resulted from four conferences in the Midwest, first organized in 1968 by Peter Schramm, Knox College, Galesburg, Illinois, and continued every other year. These publications contain information on all phases of prairie plants, animals, soils, in applied aspects and theoretical, and they should form the core of inquiry into what goes on in midwest prairies today.

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